TOPICS OF THE MONTH

Verdict on Britain's chemical engineer output

ENCOURAGING results have been obtained in a survey of the present and future supply of chemical engineers in Britain and of the difficulties experienced in obtaining suitable teaching staff. It seems that by 1966, with adequate support, the country could provide 950 chemical engineers a year, as compared with just under 300 in 1956. This is better than the minimum goal for scientists and engineers as a whole given in 'Scientific and Engineering Manpower in Great Britain' (H.M.S.O., 1957) but falls short of the estimates of some leading chemical engineers.

The new survey, carried out by the Institution of Chemical Engineers, reveals that the 'hold-up' arising from the teacher shortage is real and widespread. The increase in output which has been achieved to date owes much to enterprise and improvisation on the part of professors and other senior teachers of chemical engineering. There is the risk of some reduction in quality as a result of the difficulties experienced.

The Institution sent out a questionnaire to professors, technical college principals and heads of departments in Great Britain. In their replies, many of the heads of university chemical engineering departments express concern over the difficulty of obtaining lecturers and fears that a lowering of the professional standard might have to be resorted to.

By and large, university teachers of chemical engineering are not very hopeful about the expansion of part-time day teaching by members of the staffs of industrial concerns. What is needed in the universities and colleges of advanced technology is the secondment from industry to teaching duties of qualified men without loss of seniority for periods of not less than six months, says the Institution's report. It is argued that the help which industry has already given has borne fruit and that there is justification for more interest and support, not only in the problem of the teacher shortage, but also in the extension of student apprenticeship schemes, coupled with study for university degrees (thick sandwich-type schemes), diplomas in technology (sandwich-type schemes) and Higher National Certificates (part-time day release).

The report notes that the colleges are building up the research side of their chemical engineering work as well as the teaching side. It is pointed out, however, that while a vigorous research school is an essential feature of a fully developed chemical engineering teaching department, it is doubtful whether it is justifiable to retain at college for chemical engineering research such a high proportion of first-degree men as the estimates for 1959 and 1966 indicate. In 1953 some 22% of the members of the Institution in Great Britain were employed on research and development.

Sulphur unlimited for France

ONE aspect of the Lacq natural-gas project in France which seems to have aroused less comment than it deserves is that it stands to place France in the position of being one of the world's largest producers of sulphur, ranking next after the United States. The Lacq factory is already capable of dealing with 1 million cu. m. of crude gas per day and of producing 70,000 tons p.a. of sulphur. This can be compared with the present French consumption of sulphur, which is 250,000 tons. When it is being fully worked, three or four years from now, it will produce 1,300,000 tons of sulphur a year.

When he gave these figures to a recent meeting of the Institute of Fuel in London, Monsieur A. Blanchard, president of the Société National des Pêtroles d'Aquitaine, pointed out some other ways in which the utilisation of raw materials from Lacq, such as ethane, propane, butane and gasoline, would benefit existing chemical industries in south-west France and provide incentive for setting up new industries, such as the aluminium factory which is being built near Lacq for a production of 60,000 tons p.a. The factories manufacturing nitrogen in the south-west will most certainly expand. In addition, a new company, the Société des Produits Chimiques d'Aquitaine, has been formed to build and operate a factory to produce hydrogen and acetylene by cracking Lacq gas. The hydrogen will serve for the manufacture of nitrogenous fertilisers and methanol, and the acetylene will be used for making plastics.

Chinese chemical and petroleum progress

IN aiming at catching up with Britain in industrial production in just over 15 years, China is setting itself a somewhat ambitious task for a country whose immediate need is to raise agricultural output and whose industries are hampered in their growth by lack of capital, power supplies and internal communications. However, the country's newly acquired energy and enterprise in building up its industries are not to be taken lightly and Chinese factories brought into production recently cover a surprising range of manufactures.

That much of China's industrial planning is related to the need to increase agricultural production is illustrated by the fact that the output of chemical fertiliser is to be raised during the Second Five-year Plan from the 1957 figure of over 700,000 tons to somewhere between 5 and 7 million tons. Three new plants are to be started in Kwangtung and Kiangsi. A nitrogenous fertiliser plant in Canton will have a capacity of 200,000 tons; a phosphate plant in Chenkiang

(Tsamkong) will have a similar capacity; and a nitro-lime plant in Kiangsi is to produce 20,000 tons of calcium carbide and 20,000 tons of nitro-lime.

Other planning in the chemical field includes the establishment of a mechanised saltfield on Hainan Island for the production of salt, potassium chloride, magnesium chloride and bromide; a new sulphuric-acid plant (capacity 40,000 tons) in Tientsin; plants for organic synthetics such as *Vinlon* and PVC in the same city; and plants for the production of man-made fibres, including rayon and viscose staple fibre, in Antung Liaoning. The Peking synthetic fibre factory, with an estimated annual capacity of 380 tons of *Chinlon* (nylon 6) is due to begin operations next year.

Will China become one of the world's great oil powers? The country has very extensive oil deposits but lacks the means of effecting any spectacular increase in production. In *World Petroleum* for February, G. G. Rosu points to the scarcity of steel and investment funds as limiting factors. The same author points out that, while the Yumen refinery is still China's largest unit—its throughput capacity was enlarged to some 8,000 bbl./day in 1955—Lanchow is destined soon to become the country's main refining and oil distribution centre. A new refinery has been under construction here since 1955. It was scheduled to go on stream in part during this year after the completion of the 548-mile Yumen-Lanchow pipeline. Another refinery, Tushantze, is in the process of further enlargement. On the east coast, the small distillation units at Daren, Chiusien and Shanghai are processing whatever quantities of Yumen crude oil could be supplied overland.

To supplement oil supplies, a synthetic-fuel plant is to be erected at Fushun, with installations to be supplied by the Soviet Union. Raw material will be drawn from new reserves of bituminous coal which have recently been discovered in the Fushun area. At low-temperature distillation, this coal yields 60 bbl. of synthetic liquid fuel per 100 tons of coal. With this addition, China's total shale-oil and synthetic-fuel production capacity may be up to 15,000 bbl./day by 1962. Further expansion in oil-from-coal production, Mr. Rosu notes, is blocked by shortage of steel and electric power.

Probing chemical reactions set off by atomic radiation

WHAT happens during a chemical reaction that is catalysed or set off by atomic radiation? With the help of a new research tool, a high energy linear electron accelerator, scientists of America's Argonne National Laboratory will seek an answer to that question. The accelerator is expected to be in operation by autumn this year.

They hope to detect directly the short-lived intermediate products of radiation-catalysed reactions. Knowledge of these primary products and their basic reaction mechanisms, they feel, will help science better protect living organisms from radiation effects. This knowledge also may enable scientists to use radiation better to preserve foods and to produce new chemical products.

The accelerator will emit intense bursts of electrons, creating short-lived bits of matter such as ions and free radicals in sufficient concentration to allow direct identification. It will also be used to study radiation damage and nuclear chemistry.

Titanium melting progress

NOW that the big new titanium melting furnace has been brought into operation at the Kynoch works of Imperial Chemical Industries Ltd. it will be possible to produce larger ingots. This has been demonstrated by successfully melting an ingot weighing 4,200 lb.—claimed to be the largest ever produced outside the U.S.A. The availability of such large ingots will widen the scope of titanium fabricating techniques. For one thing, it will now be possible to roll the slab into long coils by strip-rolling techniques so there will be no need to weld small coils together.

For the producer, production of larger ingots has another big advantage. It increases yield by decreasing surface/volume ratio. Any reduction in process scrap is, of course, a most significant factor, because titanium is still a relatively expensive metal.

The new I.C.I. furnace is one of three supplied to the company by W. C. Heraeus GmbH. Using the consumable electrode arc melting process it will normally operate with a high degree of vacuum, a pressure of under 10 microns being maintained throughout the melt. Facilities are also provided for melting under a reduced pressure of an inert gas, should this be required.

Particularly useful are features which reduce 'down time' between melts and effect big improvements in furnace utilisation.

Prizes for inventors

WITH the idea of stimulating British engineering invention, a Leicester firm of textile and general engineers and stainless-steel plant specialists is now offering a prize of 100 guineas and a royalty, with prizes for runners-up as well, to the winner of a competition for new inventions. The idea is that the firm will take up any inventions that seem to meet a universal need and launch them on the market, mainly for export. This firm may well be inviting an onslaught from the inventors of all those crazy gadgets which oblige Patents officials to become Patience officials, and which are often only one step removed from the upside-down lighthouse for submarines or the revolving goldfish bowl for tired goldfish.

All the same the idea might prove fruitful, for there is undoubtedly an untapped wealth of inventive genius which never finds an outlet. The pity of it is that competitions in general are most successful when the main requirement is merely luck and not anything so tedious as original thought.

New-style transport for chemicals

THE carrying of chemicals in road tankers, railway tankers and even sea-going tankers, as opposed to the use of drums, bags, carboys, etc., is a relatively new development as far as British exports are concerned. It is bound to be of increasing significance with the advent of the European Free Trade Area.

This fact was noted by Mr. R. E. Rushden (I.C.I.) at the recent Packaging Conference of the Association of British Chemical Manufacturers. The probability of increased bulk road and rail delivery, where E.F.T.A. is concerned, was confirmed by Mr. G. L. Riddell, of the Reed Paper Group, who pointed out that there is, however, a relatively new field of packaging which merits the close attention of the chemical industry.

It is the intermediate bulk container which is really a large sized package containing between 1,000 and 3,000 lb. To handle loads of that weight obviously mechanical devices of some kind or another are necessary, but these can be of the simplest kind—just a hoist and a dolly will do in many cases.

These intermediate bulk containers may be of various kinds; for pastes and viscous liquids, it may be a very large plastic collapsible tube which is delivered to the customer like a sausage, emptied by rolling up from the end furthest away from the nozzle and returning for refilling in the rolled up state. Another kind of I.B.C. is a large paper sack which is contained in a collapsible wire-mesh crate for additional strength. The paper sack is expendable and the wire-mesh crate is collapsed and returned.

Yet another kind, which is non-returnable, is the large fibreboard case with or without a liner, which may stand on a fibreboard expendable pallet or on a wooden pallet with supporting wooden beams at the sides and cross members at the top, the whole being secured by steel strapping. Another device is the large tank (100 gallons upwards) which is delivered and collected when empty. These devices have excited interest in the U.S.A. and are now being looked at seriously in some quarters in Britain for the delivery of both ' wet ' and ' dry ' chemicals.

Plastics in Spain

A SOMEWHAT frustrating situation confronts the plastics industry in Spain. Spanish manufacturers of raw materials for plastics can supply only some third of the total products now being consumed by the well-developed fabricating industry, which is obliged, through lack of local and imported raw materials, to curtail production severely. It is estimated that to satisfy the real needs of the fabricating industries the latter would require some 50% more in the way of plastics and synthetic resins. However, as long as there is no improvement in Spain's foreign currency position, it is to be expected that annual imports from all sources will continue to be in the region of 9,000 tons.

Total production in Spain amounts, at present, to some 5,000 tons of plastics, and this output is mainly confined to phenolic, urea and vinyl resins and, in smaller proportions, to cellulosics. The capital invested in the raw plastics industry is estimated at 500 million pesetas.

A special feature and problem of the Spanish plastics fabricating industry is that, owing to these import difficulties and the need to import a large percentage of their requirements of synthetic resins and other raw materials through special accounts and barter deals, the prices of their goods are extremely high, so much so that there is little demand for them for industrial purposes. Consumer goods and novelties, on the other hand, have been able to stand this higher cost in the raw materials.

A report on the market for the raw materials of the plastics industry in Spain has been issued by the Export Services Branch of the Board of Trade in London. British exporters of raw materials who are interested in further details should contact the Board, quoting ESB/3593/58 as a reference.

Short cut to power?

CONVERSION of thermal energy direct into electricity is one of the engineer's pipe dreams, which now comes a stage nearer realisation. Nuclear power has placed within man's grasp almost unlimited energy, and the great nuclear reactors which are being built in Britain will be turning out enormous amounts of heat. Unfortunately, the conversion efficiency is low, and the electrical output is not very impressive when compared with the calories originally generated by the nuclear fission.

From the General Electric Laboratory, U.S.A., comes news of what may prove to be a revolutionary new device for overcoming this difficulty. Developed by V. C. Wilson and still very much in an experimental stage, the device has a conversion efficiency of only 8%, so that it could not hope to compete with the conventional use of turbogenerators. It is, however, superior to the thermocouple and the thermogalvanic cell, both of which have efficiencies of only about 1%. Semi-conductors can convert heat directly into electricity, with efficiencies which might attain 8%, but the new apparatus, it is hoped, will eventually prove 30% efficient.

A tube containing a low-pressure gas is provided with two electrodes, one of which is cold, the other hot. The hot emission electrode, if heated electrically for about 0.008 sec., discharges electrons which complete the circuit by migration to the cold electrode. By careful design of the electrodes, the gas and the materials used, it is hoped that it may be possible to maintain an efficient flow of electrons. The promise of this device depends on the fact that the initial heating of the hot electrode need not be performed electrically, but may be done by ordinary thermal energy, perhaps from a nuclear reactor.

It must be emphasised that this thermionic converter is very much in its infancy, but it is based on a conception which may well lead to big advantages and possibilities.

U.S. aluminium projects get reshuffled

THREE important new aluminium plants are to go into limited production in the United States this spring and to be producing at full capacity by the end of the year. They are a 350,000-ton alumina plant at Burnside, Louisiana, and two 60,000-ton primary aluminium plants in the Ohio River Valley, which is rapidly becoming an important centre of this fast-growing industry.

One of the principal reasons for the industry's movement to the Ohio River Valley is the recent research into the utilisation of bituminous coal, proving that it can provide economical power for aluminium production. In the fore of this research have been mining engineers of Olin Mathieson Chemical Corporation and, originally, in 1956, this company intended to build a fully integrated plant with a planned capacity of 60,000 tons aluminium a year in the Ohio Valley, as outlined in CHEMICAL & PROCESS ENGINEERING, 1956, **37** (4), 137. Later that year, however, this plan was changed with the formation of the Ormet Corporation (formerly known as Olin Revere Metals Corporation). Jointly owned by Olin Mathieson Chemical Corporation and Revere Copper and Brass Inc., Ormet will serve as a producer of primary aluminium for the two firms. It will produce 180,000 tons of primary aluminium annually, of which Olin Mathieson will receive 120,000 tons and Revere 60,000 tons. The former will thus receive twice its originally planned quantity.

Another change of plan was that of moving the location of the alumina plant from the Ohio River site between Clarington and Hannibal, Ohio, to Burnside, Louisiana, on a deep-water section of the Mississippi River, about 30 miles south of Baton Rouge. This permits the direct transportation of bauxite from Surinam, on the north-east coast of South America, by ocean-going vessels.

The Burnside plant will process approximately 700,000 tons of bauxite a year. The 350,000 tons of alumina produced will be barged up the Mississippi and Ohio Rivers to Ormet's reduction plant at Omal, Ohio, where 180,000 tons of primary aluminium will be produced annually. At the end of the ingot line at the reduction plant, the joint effort between Olin Mathieson and Revere will end and the two companies will become competitors in the production and sale of finished aluminium.

Half of the 120,000 tons of primary metal for Olin Mathieson will go to their Clarington fabricating plant. Here, in a series of cold mills and hot mills it will be transformed into finished sheets and coils. The other 60,000 tons will be destined for Olin Mathieson plants at East Alton (Ill.), Gulfport (Miss.), Chattanooga (Tenn.), and Riverside (Calif.). The 60,000 tons of primary metal received by Revere will be fabricated at plants in Baltimore (Md.) and Chicago (Ill.).

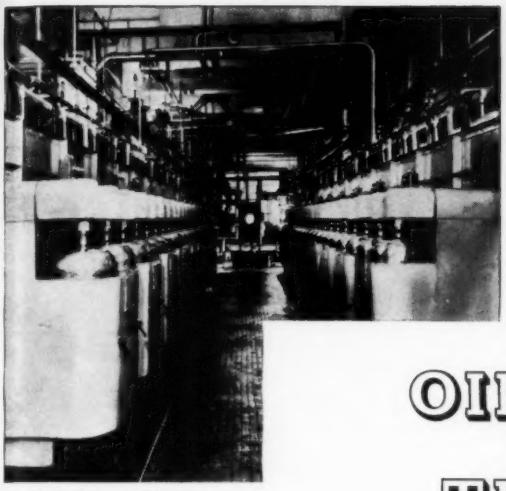
On completion of the new facilities, Olin Mathieson will become the fourth largest aluminium producer in the United States industry.

Power for the Ohio River Valley aluminium facilities will be based on coal and will be generated at Cresap (W. Va.), across the river and slightly upstream from the metal production plants. Three 225,000-kw. units are being installed, of which two will be owned by the Ormet Corporation. Ohio Power Co., a subsidiary of American Gas and Electric Co., will own the third and operate all three units. The first unit at the power station will be completed this spring, with the second and third units installed and operative in the summer and autumn.

A hot spot

THE analysis of temperatures, particularly those lower than 1,000°F., can frequently be a problem, and overheating resulting from faulty welds, defects in castings or insulation leakage may not be detected until it is too late to relieve the trouble. Now the application of infra-red photo techniques can be used over a wide range of equipment, from a test-tube to a cracking plant, to detect temperature differences as small as 0.02°C.

Using a *Barnes* far-infra-red camera and a standard Polaroid land camera film the infra-red radiation of all types of objects is converted into black-and-white pictures with accurately measurable temperature gradations. Each point on the photographic image indicates the heat being emitted by that point, and can be converted into temperature readings. The camera is sighted on the object to be photographed. An internal mirror scans across the field of view for several minutes, while an ultra-sensitive, fast heat detector in the radiometer picks up the radiation emitted by various points of the object. This modulates a light beam, and the more intense the radiation detected the brighter the beam. The modulated light beam is simultaneously scanned over the film in the corresponding pattern, the light areas on the picture corresponding to areas in the object which emit the most heat; dark areas mean less heat. The camera's angle of scan can be adjusted either for a 5° or 10° vertical field, while the horizontal field can be 20° or 10°. Sensitivity can also be adjusted so that very small temperature differences can be detected, or only gross ones. The importance of thermal photography in industry need not be stressed. Potential trouble sources may be recognised in good time and this instrument used as a safety measure or purely analytic device.



A Sharples continuous vegetable oil refinery.

A CPE Chemical Engineering Review

OILS AND FATS TECHNOLOGY

By M. K. Schwitzer, M.I.Chem.E.

Oil extraction; refining of oils; food fats and their packaging; fatty acids and fat chemicals

LITTLE of outstanding merit or novelty has been published during the past 18 months as far as the technology of oils and fats is concerned. There has, however, been intensive research activity in the field of dietary fats and their influence on health, especially on the incidence of atherosclerosis. This has even been taken up by the popular press where science editors apparently found in the mysterious cholesterol a welcome change from the more humdrum subjects of space travel and the I.G.Y. Witness of the great scientific activity in this field are the many articles published.

A detailed treatment of this subject is outside the scope of a review on the technology of oils and fats, but inasmuch as any new knowledge on dietary fats could have an effect on technology, it might not be out of place to indicate here what the present scientific enquiry is about. Additional information can be obtained from the literature, such as the Symposium on Fats in Nutrition and Health[1] and Morton's[2] paper read in London (March 15, 1957) before a meeting of the Oils and Fats Group of the Society of Chemical Industry.

Fats and coronary disease

The basic observation which stimulated research on this subject is the association between coronary diseases and a high level of cholesterol in the blood. Cholesterol is found in the body in a free or a bound form. In the blood more than half of the cholesterol is bound to fatty acids (cholesterol esters) or to proteins (lipoproteins). It has been discovered that the cholesterol level in the blood depends not only on the quantity of fat in the diet but also on the quality of the fat. The higher the percentage of saturation of fatty acids in the fat the higher the cholesterol level; the higher the percentage of unsaturated acids, the lower the cholesterol level. Fats containing a relatively high percentage of unsaturated fatty acids such as sunflower, maize and other vegetable oils and also fish oil actually lower the blood cholesterol level if they are substituted in the diet for saturated fats such as animal fats. They tend to neutralise the cholesterol-raising effect of saturated fats when they are added to a diet high in the latter. Linoleic, linolenic and arachidonic acids—the so-called essential fatty acids—are those that lower the cholesterol level and therefore reduce the risk of deposits being formed in the arteries. Of these, linoleic acid cannot be synthesised by the mammal body.

Oil extraction

Burner[3] reviews recent developments in the use of screw presses. Perhaps the most important step in the development of mechanical pressing was the introduction of the continuous screw press. The importance of proper cooking prior to pressing, especially in the case of cottonseed meats, is stressed. It was soon discovered that, to prepare a material for screw pressing, more cooking capacity was required than when preparing it for hydraulic presses. With modern screw presses it is possible to get very high oil-extraction rates. It was proven that it is possible to operate continuously and to leave consistently less than 3% oil in the finished meal. This can be improved to even 2.5%, but at the expense of a somewhat lower capacity. One of the latest developments in screw-press construction is the use of a vari-speed motor

which permits changing the speed of the press quickly and easily without requiring special equipment.

The traditional way of producing coconut oil is to split the nuts and break them into pieces, which when dried are the copra of commerce. This is pressed in two stages in hydraulic presses, though screw presses are now mostly in use. The residual cake can be solvent extracted. A method has been patented[4] which permits the direct extraction of the oil from the fresh undried coconut pulp. Plant required is relatively simple and it is claimed that very good yields are obtained.

In the solvent extraction of oils, the recovery of the solvent for re-use is important from the point of view of overall economics. A well-designed meal de-solventiser is therefore essential. A patent[5] for an improved de-solventiser for extracted oil cakes describes a series of closed, steam-jacketed kettles arranged vertically one above the other. The cake, which is in the form of loose, small particles, passes downward from kettle to kettle in portions and in countercurrent to a flow of steam.

Solvent extraction using acetone

An original combination of a solvent extraction and miscella refining process was described by Vaccarino.[6] The solvent used is acetone. Though for a number of reasons acetone is potentially a good extraction solvent, it has never been employed on a large scale mainly because it is also a powerful solvent for pigments and other impurities. This disadvantage is overcome by carrying out alkali neutralisation of the oil in the miscella (*i.e.* the oil in the solvent). Some 1.5 to 2 volumes of acetone are required per volume of crude oil. Caustic soda is added in a highly concentrated form (40 to 50%) in water. Neutralisation is aided by powerful stirring when a dry soapstock is formed. It is virtually free of water due to the dehydrating power of acetone. Warm water is added which dissolves the bulk of the acetone. The soapstock forms a bottom layer above which there is a layer of neutralised oil containing 8 to 10% acetone, which can be readily removed afterwards. A 50 tons/day cottonseed plant based on this process is in operation in Venetico Marina in Italy. A good coloured cottonseed oil is being produced and the Wesson loss is only 1.2 to 1.6 compared with a Wesson loss of 2 to 2.5 if the same type of oil is neutralised in a traditional batch refining plant.

Oil refining

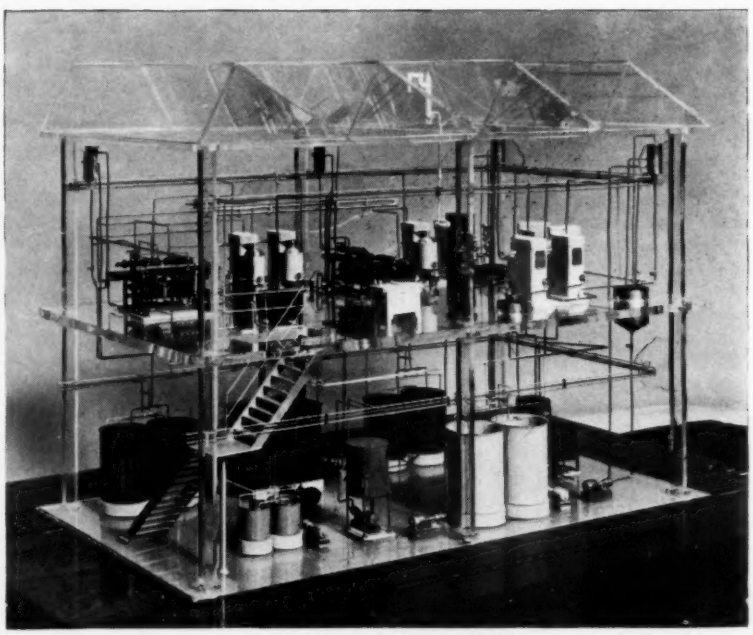
James[7] reviews refining and bleach-processes, also the degumming operation carried out, mainly on soya bean and linseed oils, prior to neutralising. He summarises the merits of the various continuous refining processes such as the conventional caustic soda method, the full and modified soda ash methods, the 'low loss' and the 'quick mix' processes, as well as miscella refining. On the latter method, which is of rather recent date, he makes some interesting comments. Operating costs of this method should be lowest providing, of course, that the plant is immediately adjacent to a solvent extraction plant. The same labour force that is used on the extraction plant is used for refining and the soapstock obtained can be disposed of in the meal. However, the process is not as simple as it appears. Considerable difficulty is encountered in obtaining efficient contact between the caustic soda solution and the miscella. Full coagulation of the phosphatides and absorption of the colouring matter do not occur in the course of ordinary mixing such as is satisfactory for straight crude oil and lye. To obtain complete refining and decolorisation of the dissolved oil a homogeniser is used or a non-ionic surface-active agent is added.

On bleaching, James discusses various adsorbent clays and other decolorising materials and ends with a brief description of continuous bleaching plants.

A continuous refining process using ammonia as the neutralising alkali was patented by Clayton.[8] The crude glyceride oil is mixed with 1 to 3.5% of aqueous ammonia and the resulting mixture is centrifuged at 140 to 175°F. The aqueous effluent contains the gums which are recovered after dilution of the effluent with 1 to 3 parts of water.

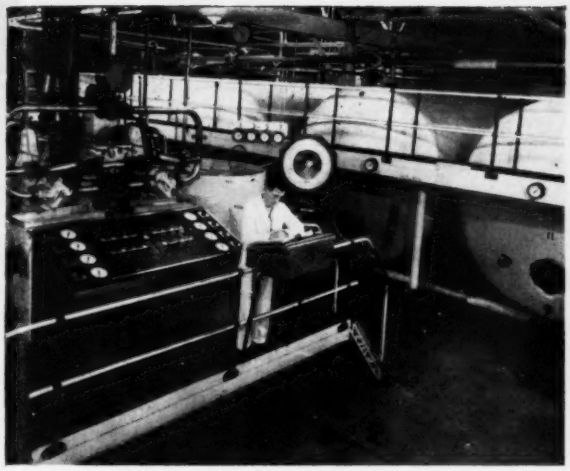
An Italian plant for neutralising fats by means of de-acidification was described by Baroni.[9] It does not differ greatly from similar plant used elsewhere. The fat to be treated may first be acid-washed, bleached with earth and filtered. It is then pumped in a continuous stream through a heat exchanger where it is heated by means of the de-acidified oil. From there the feedstock enters into a horizontal distilling/deodorising still *via* a de-aerator. The still is heated and held under vacuum sufficient to cause free fatty acids to evaporate which are recovered in a condenser. An example is given of a lard with an initial F.F.A. of 7.66% which is reduced to 0.3% F.F.A. after treatment. During processing the peroxide number increased from virtually nil to 11. It is not stated whether the de-acidified lard was fit for human consumption.

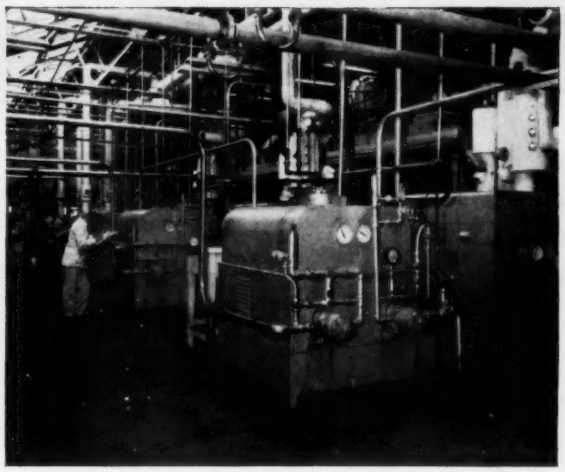
Passino[10] describes in a recent patent



[*This photo and photo on page* 153 *courtesy Sharples Centrifuges Ltd.*

Model of 'low loss' vegetable oil refinery.





Manufacture of bakery margarines and shortenings at the Bromborough factory of Craigmillar and British Creameries Ltd. (part of the Unilever organisation). *Left:* **Oil blending room with semi-automatic control panel.** *Right:* **A line of 'Votators' which cool and plasticise the oil blends.**

a method for refining vegetable oils according to which colour bodies and poly-functional acids are removed by solvent extraction. The extracted oil is steam treated to remove solvent and odorous trace compounds.

Stansbury *et al.*[11] studied the influence of different processing methods on 99 samples of acidulated cottonseed oil soapstocks. This information is desirable for the efficient and economical utilisation of soapstock. They found that soapstocks from direct solvent-extracted oils contained the least total fatty acids (unoxidised) but the most oxidised fatty acids. The samples from hydraulically pressed oils averaged highest in total fatty acids and lowest in oxidised acids. Those from oils produced by other processes did not differ greatly from the samples derived from hydraulically pressed oils with respect to these features. Soapstocks obtained by batch refining hydraulic crude oils had consistently a high neutral oil content. Most of the samples from screw-pressed and pre-pressed solvent-extracted oils also contained relatively large amounts of neutral oil, while most of those from direct-extracted oils were relatively low in neutral oil. Gossypol content was one of the most variable constituents. The samples from direct-extracted and high-speed screw-pressed oils were comparatively high in both gossypol and phosphatides, whereas those from hydraulic oils were quite low in each of these constituents. The composition of the total (unoxidised) fatty acids from soapstocks was in the same general range as usually found for cottonseed oils, with the exception that the oleic acid contents averaged somewhat lower and the saturated acids somewhat higher. These differences may result in part from the presence of small amounts of iso-linoleic acids.

Suriano[12] was granted a patent for continuously deodorising fats or oils. According to the invention the feedstock is preheated and is then allowed to flow on trays inside a column and counter-current to a stream of stripping steam.

Food fats and nutrition

Several papers have appeared on the technology of table oils, margarine, shortenings and other food fats. Some of these are reviewed below.

In the conventional method of winterising oils to produce high-grade table and salad oils, high-melting-point components are separated out by filtering. Ayres[13] was granted a patent for achieving the same result by means of centrifugal separation.

McGowan *et al.*[14] patented a process for manufacturing margarine according to which an emulsion formed by mixing liquid fat and the aqueous phase is passed continuously through a chilling stage to provide a super-cooled slurry in which crystallisation starts. This slurry is then blended with a recycled portion of slurry which has been subjected to mechanical working. A portion of the blend is held for completion of crystallisation under quiescent conditions, and the remainder of the blend is subjected to mechanical working.

Proper packaging of margarine and other food fats is of greatest importance in the economy of food distribution and is essential in keeping the full nutritional value of the packed goods on their way from producer to the consumer *via* distributor and the retailer. A useful contribution to the rationalisation of food fat packing was made by Kalkschmidt,[15] who describes automatic moulding and packing machines such as the Benhil *Multipack* 46. Packing costs and other useful data are given. The influence of packing materials on the smell of the packed fats is discussed by Jellinek.[16] A source of unpleasant smells can be the inks used for printing the wrapping materials. This can be prevented by careful choice of the printing inks. If paper is used as wrapping material, this should be of the steam-treated type to ensure freedom from smell. The author tabulates the various types of smells encountered in packing food fats and their sources; he describes the methods used for analysing smells and concludes with a suggestion for rating smells. Stief[17] and Calmus[18] deal with industrial packaging methods and with automatic wrapping machines respectively. These machines can not only use paper but also synthetic plastic films, aluminium foils and other materials. Debus,[19] finally, describes the various packing materials available for margarine and other food fats today. These include viscose and acetate films, polythene, PVC, polyamide, polyester, polyvinylidene and other plastic films. Laminates in which one layer is usually aluminium are used increasingly, as they give the best protection, though are somewhat more expensive. The author describes methods for testing packaging materials and lists the more common ones, giving their resistance to solvents and

also such constants as specific heat, transparency, water absorption, light fastness, inflammability and keeping quality.

The preparation of a plastic shortening is the subject of a patent by Lutton.[20] Partially hydrogenated base stock is blended with a small amount of hard stock, containing crystalline solids predominantly in the β-phase. The base stock has an iodine value between 80 and 95, and at least 87% of the glyceride fatty acids have 18 carbon atoms. The hard stock contains not less than 90% of C_{18} fatty acid radicals in the glycerides and has an iodine value less than 10.

A pan grease for releasing bread and other goods from baking tins is the subject of a recent patent.[21] The pan grease is made by mixing 64 g. of technical glyceryl monostearate (composed of approximately 50% mono-, 25% di-, and 25% tri-glycerides) and 16 g. of sodium dicetyl citrate and boiling for a few seconds with 920 g. of water. This results in a highly stable aqueous dispersion which is easily applied to the tins.

Wurziger and Lindermann[22] describe a method for detecting a spoiled lard that had been alkali-refined. This is a valuable contribution to analytical technique with the practical result of protecting the consumer from substitutes for pure lard. The content of oxy-acids or, rather, lactones in a lard cannot be reduced substantially by either alkali refining or bleaching. If, therefore, a lard has a low Lea number and an exceptionally low saponification number, but a high extinction coefficient, then the lard in question is usually a low-grade or somewhat rancid material that had been alkali refined or treated otherwise; or it is a mixture of pure and refined materials. The test method is described in some detail and there are tabulated a number of test results.

Of a number of papers published on fat nutrition, the following raises interesting points. Reporting on a research investigation, Johnson *et al.*[23] found that thermal oxidation products from the polyunsaturated fatty acids, primarily linoleic acid, are responsible for much of the loss of nutritional value in thermally oxidised edible oils. Oils with a high linoleic acid content are more likely to undergo thermal oxidative damage than those with lower linoleic acid contents. Also the ratio of this to total unsaturated acids has some influence on the nutritive stability of an oil when it has been thermally oxidised. The products which cause the loss of nutritional value are probably polymeric in nature, but these oxidised oils contain also carboxylic acids and carbonyl groups. The liver/body weight ratios of rats fed with a diet containing the thermally oxidised oil were found to be significantly larger than the liver/body weight ratios in animals fed on diets containing fresh oil. However, the livers of animals fed with the thermally oxidised oil diets did not differ in lipid percentage or total solid content, and histopathological investigations did not show any abnormal conditions.

Producing fatty acids

While counter-current continuous fat splitting of tallow, coconut oil and other fats and oils is today a well-established practice, castor oil is still usually split by the Twitchell method, because of its chemical constitution. Lawrence and Becher[24], however, patented a counter-current continuous method of hydrolising castor oil. This is achieved at elevated pressure and a temperature of 235°C. An aqueous glycerol solution is used as the hydrolising medium, fatty acids are withdrawn at the top of the column, and the aqueous glycerol at the bottom.

For the purposes of studying the kinetics of the Twitchell fat-splitting process Fukuzumi and Koyama[25] carried out tests on soya bean and coconut oils at 35°C. compared with a temperature of 100°C. in commercial Twitchell fat-splitting operation. The promoting agent used was tetrabutyl naphthalene sulphonic acid; no stirring or shaking was used, and the process took about 30 days to reach a fatty acids yield of 90% and over. For the first time it has been demonstrated that low-temperature splitting of the fat by the Twitchell process occurs in a stepwise way. As one would expect the concentration of diglycerides reached a maximum during the early days of the reaction, and then decreased somewhat. Monoglyceride concentration appeared to reach a maximum more slowly and then continued at that level as the concentrations of free fatty acids and glycerol steadily increased. It was also found that the degree of splitting the soya bean oil was greater when the sulphonic acid was in the oil layer than when it was in the water. The reverse was true of coconut oil. Addition of coconut fatty acids to the coconut oil system had little effect, but soya bean fatty acids added to the soya bean oil system markedly increased the degree of splitting. Addition of glycerol had no effect on the degree of splitting.

A novel method of separating fatty acids or carboxylic acid esters having different melting points was patented by Stein and Hartmann.[26] Separation takes place by suspending the feed mixture in an aqueous solution of a surface-active material and centrifuging it at a temperature below the melting point of some of the components of the mixture. The surface-active agent is recovered from the separated stream.

The production of azelaic acid by ozonolysis of C_{10}—C_{24} unsaturated fatty acids was patented.[27] Instead, fatty acids, the corresponding esters, nitriles, amides or soaps can be used as raw materials.

The production of high-molecular-weight alcohols *via* the corresponding fatty acid esters was patented.[28] The acids are dissolved in a suitable solvent and esterified with a monohydric alcohol in the presence of a mineral acid at elevated temperatures. The finished esters are then reduced to the alcohols by an alkali metal/reducing alcohol process. Production of alcohols from safflower oil is covered by a related patent.[29]

Fat derivatives and synthetic detergent bars

A great many patents have been granted and several papers published on the use of fatty acids and their derivatives in a variety of products including the manufacture of synthetic detergent bars. A few examples only are cited below.

A feedingstuff additive with growth-promoting properties and made from a cationic fat-derived material was patented.[30] It is tri-methyl octadecyl ammonium stearate, and is prepared by reacting the cationic quaternary ammonium chloride with the anionic sodium or potassium stearate. Added in small quantities, *e.g.* 50 mg./kg. of feed to pigs, poultry and other animals, the compound improves the feeding properties of the ration.

A method was published[31] for epoxidising fatty acids containing an ethylenic double bond, in particular those fatty acids obtained from oils containing oleic acid. The reaction is carried out by means of hydrogen peroxide, acetic acid and a small amount of sulphuric acid in an organic solvent and at a relatively high temperature. The usual method, with peracetic acid solution, results in a waste of as much as 20% of the available oxygen.

The economical formulation of a synthetic detergent bar has still escaped

(*Concluded on page* 171)

Estimation of Gaseous Densities

By M. V. Kunte and L. K. Doraiswamy
(Chemical Engineering Division, National Chemical Laboratory, Poona)

Chemical engineering designers will appreciate the handy method of calculating gaseous densities described in this article and will find that the three charts given here will eliminate a great deal of laborious calculation.

IT is often necessary in process design to estimate the density of a gas, or of a mixture of gases, at different conditions of temperature and pressure. When the pressure involved is low, not much error is introduced by assuming the ideal gas law

$$PV = RT \quad \ldots\ldots\ldots\ldots (1)$$

to hold. Writing Equation (1) for two conditions of temperature and pressure,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \quad \ldots\ldots\ldots\ldots (2)$$

If $P_1 = 1$ atm. and $T_1 = 273°K.$, then it is known that $V_1 = 359$ cu.ft./lb. mole (22.4 litres/g.-mole). Thus V_2, and therefore the density d_2, can be computed at any temperature (T_2) and pressure (P_2). A nomogram for rapidly estimating the density of an ideal gas has been prepared by Orlicek.[1] However, due to its inherent assumption of ideal behaviour, this nomogram is of limited use in process design.

There has been a large volume of published literature on the P—V—T relationship of gases. The most useful method of expressing this relationship is to introduce a compressibility factor, z, in Equation (1):

$$z = \frac{PV}{RT} \quad \ldots\ldots\ldots\ldots (3)$$

When the variables are expressed in terms of reduced conditions (P_r, T_r, V_r and d_r), the compressibility factor can be written as

$$z = \frac{P_rV_r/T_r}{RT_c/P_cV_c} \quad \ldots\ldots\ldots\ldots (4)$$

Based on the law of corresponding states, many generalised compres-

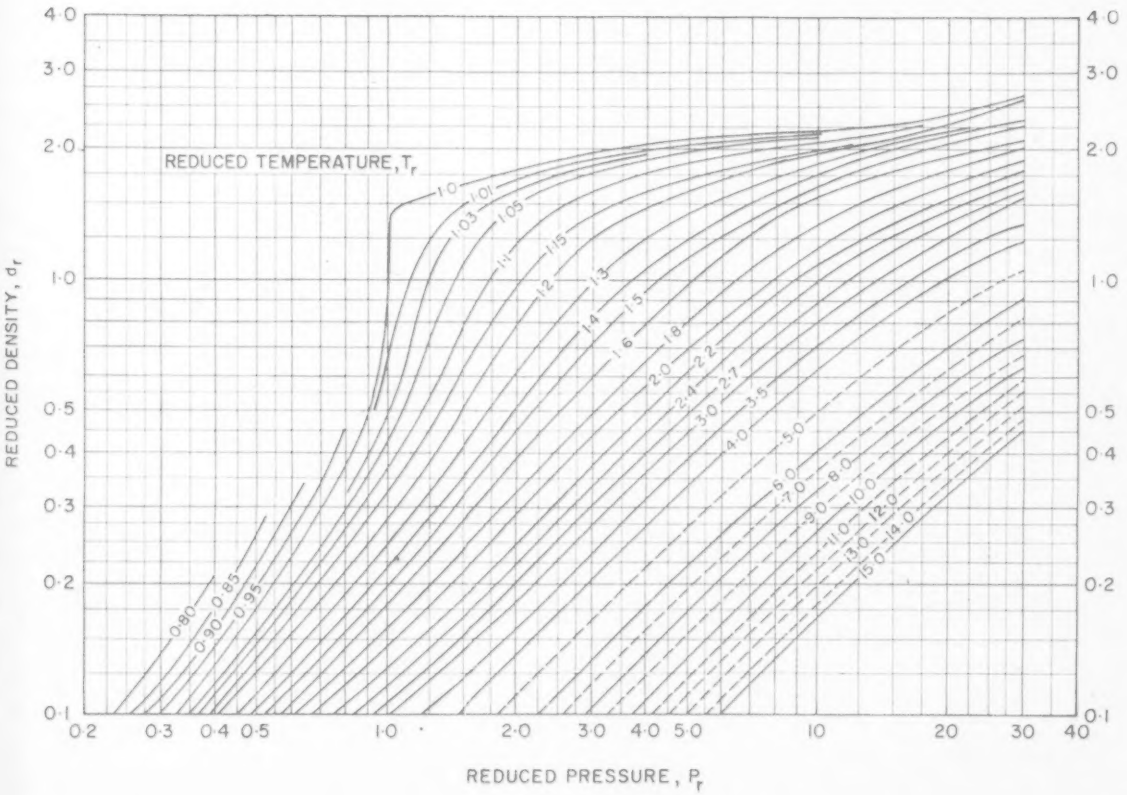


Fig. 1. Reduced density chart (high P_r range).

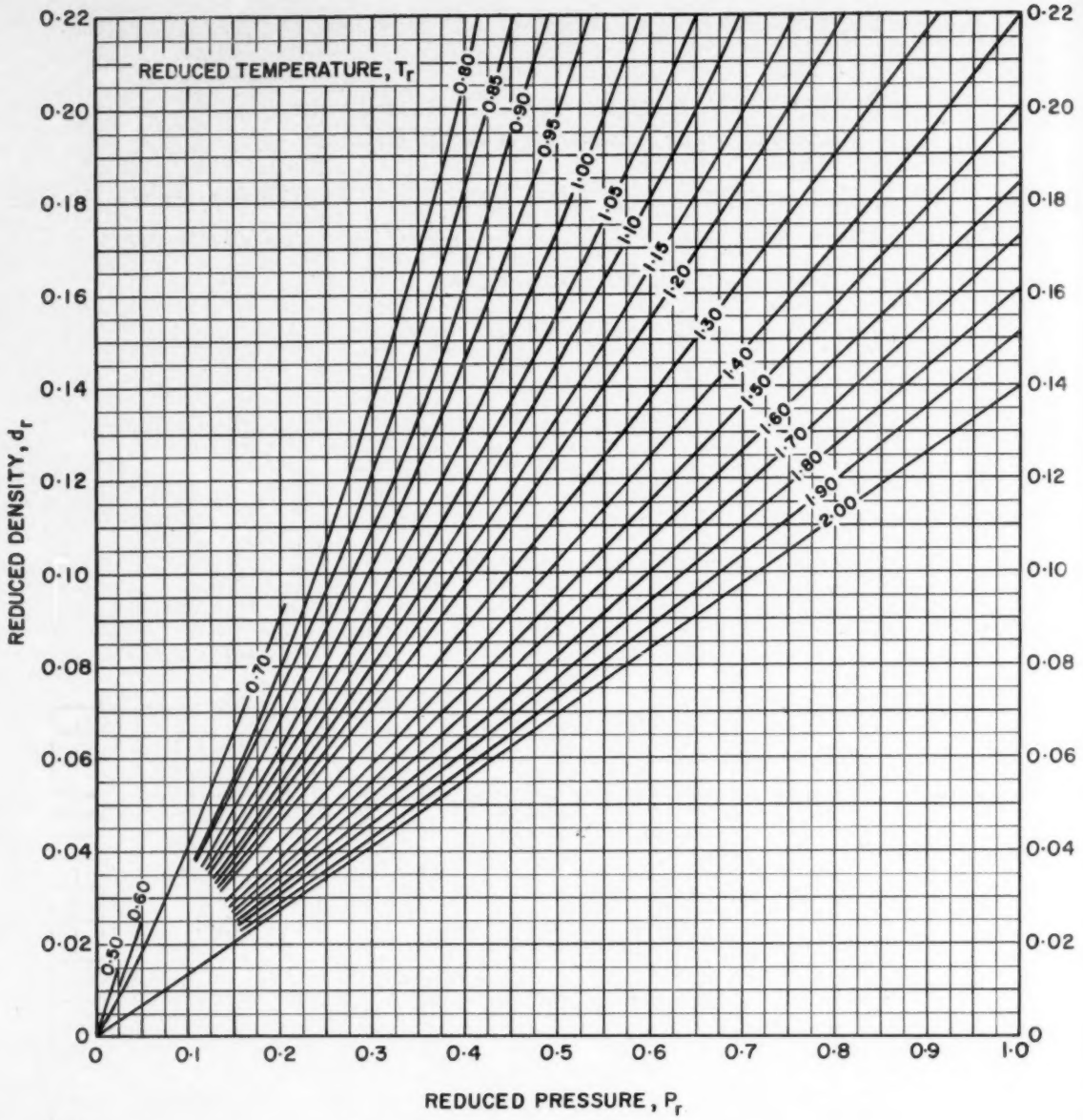


Fig. 2. Reduced density chart (low P_r range).

sibility charts have appeared in the literature, notably that of Hougen and Watson,[2] expressing z as a function of P_r and T_r.

Reduced density charts

Although gaseous densities can be estimated by use of the z-chart, it is convenient to have a direct-reading chart for design purposes. The ratio RT_c/P_cV_c is approximately constant for all gases. The average value of this ratio, as found from the experimental values for about 40 gases, is 3.65, the mean deviation being about 2%. Equation (4) can thus be rewritten as

$$V_r = zz_c\frac{T_r}{P_r}$$

$$\text{or} \quad d_r = \frac{1}{zz_c} = \frac{P_r}{T_r} \quad \ldots\ldots\ldots (5)$$

$$\text{where} \quad z_c = \frac{RT_c}{P_cV_c} = 3.65 \quad \ldots. (6)$$

It can readily be seen that equation (5) is amenable to a generalised graphical representation. A plot of d_r *v.* P_r for various constant values of T_r is shown in Fig. 1 for the higher values of P_r, while the curves for the lower P_r values appear in Fig. 2. In Fig. 1 is also included, for the sake of completeness, a range of T_r values where almost ideal behaviour is encountered.

Thus the reduced density d_r can be estimated at any temperature and pressure if the critical temperature and pressure are known; then from a knowledge of the critical density of the gas, its actual density can be computed.

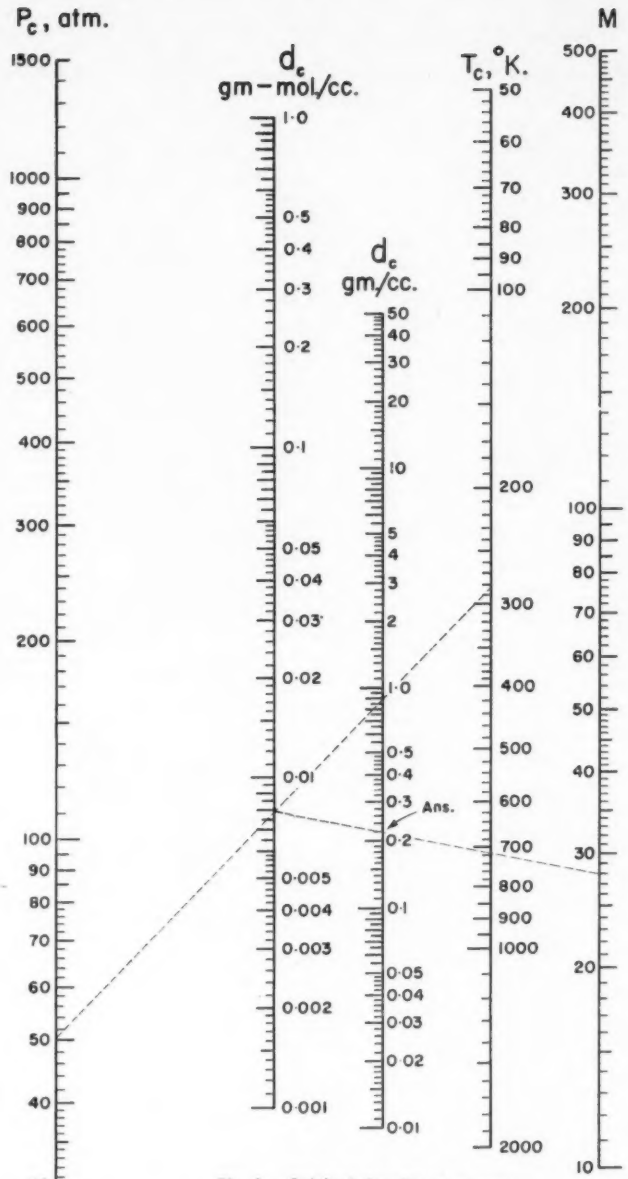


Fig. 3. Critical density nomogram.

NOMENCLATURE

d = Density, g.-moles/c.c. or g./c.c.
M = Molecular weight
P = Pressure, atm.
R = Gas law constant, 82.06 (c.c.) (atm.)/(g.-mole) (°K.)
T = Temperature, °K.
V = Volume occupied by 1 g.-mole, c.c.
z = Compressibility

Subscripts:

c = Critical state
r = Reduced state

Critical density nomogram

To determine d_c, Equation (6) may be simplified to give

$$d_c = 0.0445 \frac{P_c}{T_c} \quad \ldots\ldots\ldots (7)$$

Although the critical densities of the more common gases are available in the literature, these are not always dependable. The use of Equation (7) is consequently to be preferred, particularly as the charts presented in Figs. 1 and 2 are based on the validity of Equation (6) and therefore of Equation (7). The critical densities computed from Equation (7) may be regarded as 'ideal critical densities.' In Fig. 3 is presented a nomographic solution of Equation (7). The nomogram also contains a scale for molecular weight in order to enable determination of d_c both in g.-moles/c.c. and in g./c.c. The reduced density d_r, being dimensionless, can be used directly with either of the units to obtain the actual density.

Figs. 1, 2 and 3 are of considerable use in process design, especially in the design of chemical reactors and other equipment where the calculations have to be repeated over a wide range of temperatures and pressures. The work can be further simplified by use of the nomogram prepared by Liang-tseng Fan[3] for the rapid determination of reduced pressures and temperatures.

Example

The use of the above method is best illustrated in the solution of the following problem.

Determine the density of ethylene at 250°C. and 150 atm. The critical temperature and pressure of ethylene are 9.7°C. and 50.9 atm., respectively.

$T_r = 1.85$; $P_r = 2.95$
From Fig. 1, $d_r = 0.48$
From Fig. 3, $d_c = 0.0079$ g.-mole/c.c. or 0.22 g./c.c.
$\therefore d = d_r \times d_c = 0.106$ g./c.c.

Note

It is frequently required to calculate the density of a mixture of gases. This can be done by calculating the pseudo-critical temperature and pressure of the mixture from a knowledge of the critical properties of the individual gases comprising the mixture and the proportions in which they are present.

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[2] O. A. Hougen and K. M. Watson, 'Chemical Process Principles Charts,' p. 103. John Wiley & Sons, 1947.
[3] Liang-tseng Fan, *Chem. Eng.*, 1957, **64** (2), 288.

Chemical Plant on Show in Germany

PREVIEW OF THE ACHEMA EXHIBITION AND CONGRESS

A wealth of new developments in chemical plant and equipment, instrumentation, laboratory techniques, materials of construction and ancillary equipment for chemical plants will be displayed at the Achema XII Exhibition and Congress which is being held in Frankfurt (Main) from May 31 to June 8 within the framework of the European Congress of Chemical Engineering, 1958. In the following pages we describe a selection of the exhibits

CHEMICAL AND PROCESS EQUIPMENT

Krebs & Co., Berlin, who construct **plants for the production of caustic soda, chlorine, hydrogen, etc.,** have developed a very original method of drying wet chlorine gas. Sulphuric acid is atomised by rotating perforated cones and the wet chlorine gas passes the fine spray of sulphuric acid without pressure drop. The same principle is used for the absorption of chlorine containing waste gases and allows the continuous production of sodium hypochlorite solution. The caustic soda solution inlet is automatically controlled by measuring the oxidation potential.

A spraying apparatus of this sort, made completely in PVC, will be shown at the Achema.

The dried chlorine gas is compressed to 5 to 10 atm. in special two- or three-stage reciprocating compressors whose piston rods require no lubrication and which need less attention than previous designs. This type of compressor is also claimed to have a very low power consumption in comparison with sulphuric acid rotary compressors.

Another speciality of this company is plants for the production of synthetic hydrochloric acid. The apparatus is arranged for the production of technical hydrochloric acid, but additional equipment is available by means of which, with an appropriate change in the method of operation, it is also possible to obtain pharmaceutical and chemically pure acid. The combustion chambers can be protected against explosions by a photoelectric safety device.

Krebs also supply plants for continuous chlorination, f.i. of alcohol and benzene, and completely continuous processes for the production of DDT, BHC and insecticide dusts, synthetic phenol and phthalic anhydride. Their mercury cells, for capacities of from 5,000 to 50,000 amp. with a specific load, are provided with anode-adjusting devices, permitting regulation of the distance of the anodes from the flowing mercury band without interruption of production. (Hall 3, Stands K19, L19.)

A novel approach to problems involved in the extraction, separation and classification of solid, sub-solid, viscous, slimy or mixed materials, and in concentrating them from liquids of all kinds, is provided by a **filtration machine** making use of sonic vibrations. A screen or filter cloth is arranged in a catenary curve over a discharging funnel and, while one side of the rectangular fabric is tightly clamped at one side, its opposite side is agitated through a strip, which is fitted to it, by means of an electromagnetic vibrator. A basic vibration of 100 c/sec. is created, upon which are superimposed very high harmonic vibrations. The action of the vibrations is such that during filtering or screening the material forms into a roll which rolls comparatively slowly towards one end of the filter cloth as caused by a twist in the fabric. The actual working surface remains open, therefore, for the passing of the liquid phase of the material.

By combining several filter surfaces in a battery any required output can be achieved.

The company who will be exhibiting this machine, Rheinische Werkzeug und Metallwarenfabrik GmbH. ('Rhewum'), will also show their *Schallfix* vibratory sieving machine for test screening, cleaning and purifying, classifying and wet screening. Whereas in more usual screening methods the cloth is agitated with the frame by some means or other, in this machine the energy available for agitation is applied directly to the sieve cloth, using electro-magnetic vibrators. The machines are available with feed hopper and collecting cones and outlets to carry away the oversize, thus providing complete freedom from dust during action.

Other 'Rhewum' exhibits will include an analysis sifter, for laboratory use, with direct agitation of each screen mesh, and also a vibrator unit with a variety of applications including quality control and high-speed sift analysis. (Hall 4, Stand K14.)

Maschinenbau-A.G. Balcke will show examples of their work in the design and construction of equipment for **boiler feed and cooling water circulation systems** used in steam boiler plants in the chemical and allied industries, as well as ancillary plant. The latter include recooling plant (cooling towers with natural and forced draught, graduation plant and water vapour refrigerating plant), condensers (surface and compound condensers, pumps, steam jet pumps and compressors), heat exchangers (pre-heaters

and coolers), boiler feed, factory and drinking water treatment plants, rapid filtration plant, central heating installations, waste steam utilisation plants, gas and oil firing systems, as well as individual pieces of equipment up to the largest size, to their own or the customer's design.

The Balcke forced-draught cooling towers are provided with high-capacity fans which are coupled to reduction gearing and fluid clutches and their speed can be regulated over a wide range. They enable ample supplies of recooled water to be obtained, even in warm weather, by the use of large volumes of air. The construction and method of operation of the tower will be shown by means of a model. Another model will show the construction of the Balcke forced-draught cooling tower from prefabricated units.

The parent company are also exhibiting a fuel oil pump and preheating unit for combined gas and oil firing for a radiation boiler operating under the following conditions: bunker oil 'C,' cal. value = 9.926 kcal./kg., with an oil pressure of 30 atm. at the burners; water evaporated, 270 tons/hr. with an oil consumption of 17,800 kg./hr. using eight burners.

The Frankenthal works manufactures rotary and piston pumps and rotary and piston compressors. Standard models of several oil-free compressors will be on show. These are fitted with water-cooled jackets and cylinder heads which are used for the production of absolutely oil-free air. They have an intake capacity of 40 to 1,600 cu.m./hr. at 1,450 r.p.m. against a pressure of 8 atm. (Hall 3, Stands D12—E14.)

The new *Zenith Princess* **filter** can be used for filtering all types of liquids. All parts which come into contact with the liquid are made of stainless steel. The filter is also manufactured in a highly durable aluminium alloy, lacquered or anodised, and *Nolac*, a non-corroding light metal alloy which does not require protective lacquering. Clarification and sterilisation can be carried out in one operation by adapting the filter into a double unit, using a change-over plate. The exhibitors are John C. Carlson Ltd.

A new type of **evaporator** will be exhibited by the A.P.V. Co. Ltd. This evaporator employs plates instead of tubes and operates on the climbing- and falling-film principle. Its outstanding characteristic is its simplicity and compactness and the fact that it requires only 8 ft. of head room. Other of their products will be displayed including the A.P.V.-Cooper stainless-steel valve, which is shown in gate, tank and other types in a wide range of sizes. (Hall 1B, Stands C2—D2.)

Maschinenfabrik Theodor Hoelscher will display their ingenious inclined-rotor **pumps** which are suitable for handling sewage, sludges, etc., while a further design is aimed at overcoming the problem of pumping matter which contains a considerable percentage of textile and other fibrous substances.

Basically, the Hoelscher innovation comprises a centrifugal pump in which an inclined disc rotates as an 'inclined rotor' within the casing, being mounted on a shaft driven by electrical or other means. Such pumps are not made exclusively with simple, smooth, inclined discs as rotors, for the company have gone so far as to serrate these discs externally, like a circular saw. It might have been expected that rags, fibrous materials and the like would catch on these teeth and choke the pump, but, in fact, experiments have proved the reverse to be the case. Rags are torn to pieces by the 'saw pump.'

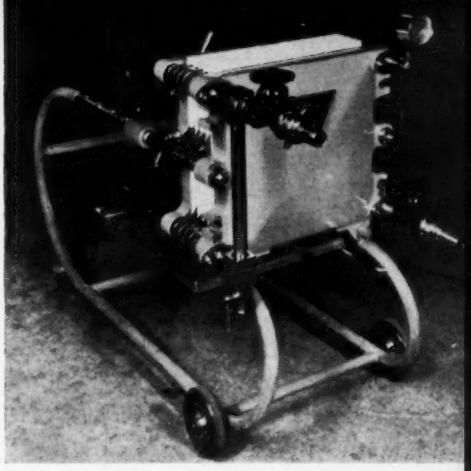
Inclined-rotor pumps are produced which are suitable not only for the delivery of waste waters with rags, filters and the like, but for thick substances such as concrete, mortar, sand, fish, turnips and the like. Fish and turnips are disintegrated.

If desired, the inclined-rotor pump can be ventilated through the hollow shaft by a rotary compressor, so giving rise to a mixture of air with the liquid. The specific gravity of thick substances is thereby reduced and the pump attains greater delivery speeds.

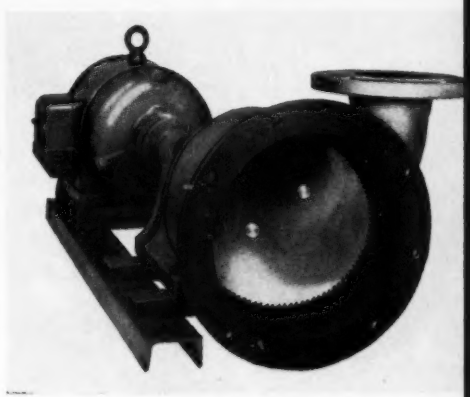
As proof of the performance of these pumps, Hoelscher cite the case of a unit constructed for trial purposes with a housing diameter of 80 mm., the housing width being also 80 mm. It was doubted at first whether such a small unit with its 1¼-in. connections would be able to handle such difficult substances as molasses, etc., but the machine has in fact handled various difficult substances with ease and had a delivery height of 15 to 20 m., depending on the speed. With it, pumping of newsprint or similar materials is possible. (Hall 1C, Stand B5.)

Sutcliffe, Speakman & Co. Ltd. will display one of their continuous solvent recovery plants, a newly designed small double-adsorber recovery plant and some special-purpose **active carbons.**

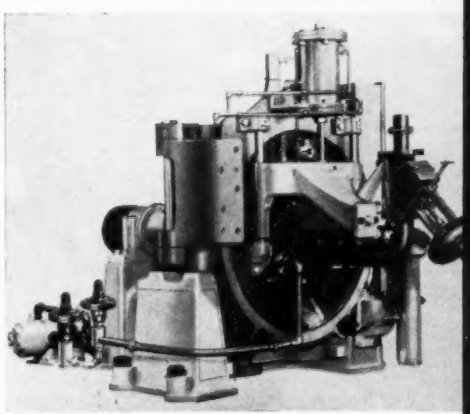
In the continuous solvent recovery



Carlson's 'Zenith Princess filter.



Inclined-rotor pump by Hoelscher.



New Sharples C-41 'Super-D-Hydrator' and (*below*) **high-pressure heat exchanger for phenol synthesis (Krebs).**

plant only one adsorber is used. This adsorber, which is sub-divided radially into compartments each containing a carbon bed, is disposed horizontally and rotates slowly in a chamber into which is directed the solvent-laden air stream. As the adsorber rotates the compartments pass in turn through a positively segregated steaming zone wherein the isolated carbon bed releases the solvent which it had adsorbed during its passage through the adsorption chamber. The system is continuous and automatic. All the ancillary equipment—fan, air filter and heat exchanger, adsorber drive mechanism, condenser, solvent decanter, interconnecting pipework and even a vacuum cleaning system for the air filter—have been built within the outer case containing the adsorber.

The small static adsorber plant exhibited is a double-adsorber unit of new design complete with all ancillary equipment but arranged compactly as a 'packaged' unit. It can be fitted for either manual or automatic operation.

Amidst the display of special-application active carbons will be particular grades Sutcliffe, Speakman have developed, such as their carbon for purifying the process solution in the production of butadiene and that for use as a catalyst support in the manufacture of vinyl chloride. (Courtyard, Stands 4 and 5.)

Bottling machines of the type used by pharmaceutical firms will include a rotating, fully automatic vacuum filler, suitable for glass and plastic bottles of 50 to 1,000 c.c., equipped with variable gear to enable an output of up to 9,000 bottles/hr. Also to be shown by the same firm, H. Strunck & Co., is a machine for cleaning, filling sealing and printing or labelling of ampoules with an hourly output of up to 4,000 ampoules. Another feature will be a heat-sealing labelling machine which is a new development. (Hall 5, Stands B3, C3, D1—3, E1—3.)

Vibration **colloid mills** for grinding, mixing and homogenising a variety of materials will be exhibited by Kolloidtechnik Probst & Class GmbH. These machines can be used in a variety of industries such as the chemical, pharmaceutical, paint, petroleum and cosmetic industries. Outputs range from 40 to 4,000 lb./hr., the machine being directly coupled to a three-phase motor of special design. According to the makers, a combination of rhythmical vibrations of high frequency and of cavitation forces in rapid succession bring the grinding substance down to colloidal size and even

Vibration colloid mill by Probst & Class.

break open the cell structure. This feature is claimed to lead to considerable homogenising power. (Hall 4, Stands B13, C13.)

A pure sulphuric acid absorber giving high yields from modest-sized equipment and a 100-litre steam-heated distillation unit are among the most interesting of the exhibits which Q.V.F. Ltd. will show. The first is a form economically scaled down from the standard absorber. It is capable, however, of producing in 24 hr. 1,250 lb. of 98% sulphuric acid from a gas stream of 6% SO_3 in air.

The 100-litre distillation unit is intended primarily for operations in vacuum conditions with materials which decompose before boiling point is reached or which respond better when operating pressure is reduced. Optimum results are attained with steam at 50 p.s.i.g. passing through the coils of the reboiler, which will give a temperature of 148°F. Its high potential can be gauged from the fact that even at atmospheric pressure it is capable of evaporating 10 gal. of water or 26 gal. of ethyl alcohol per hour, using steam at 50 p.s.i.g.

Other Q.V.F. exhibits at Achema comprise an 18-in. packed tower with reflux condenser of 60 sq. ft.; two reflux distillation assemblies for fitting to glassed-steel vessels; a 1-in. climbing-film evaporator; a 200-litre flask with improved type of stirrer; and a cascade cooler with over 700 ft. of 2-in. bore tubing. (Hall 2, Stands B7—8, C7—8.)

A variety of **chemical plant** and equipment will be shown by Dr. Otto Säurebau und Keramikwerke, whose activities include the planning and construction of complete plants for the surface treatment of steel and metals for the neutralisation and purification of industrial waste water, exhausting and destroying harmful gases, production of sulphuric acid, leaching of copper ores and for the cellulose and synthetic fibre industry. The company also build storage plant for corrosive materials with auxiliary equipment. (Hall 3, Stands 12/13—J11/12.)

Sharples **Centrifuges** Ltd. are showing models from the increased range of *Super-D-Hydrators*. The new C41 model extends the capacity range upwards, whilst maintaining the high

New A.P.V. plate evaporator.

centrifugal force characteristic.

Several new features have been introduced into the *Super-D-Hydrator* range, including a hinged-type faceplate to permit easy access to the basket; a rotary knife for handling 'hard to discharge' crystals; a new rake-type leveller for use with fine, slow-draining crystals; and a two-compartment casing with provision for recycle of overspill.

In the new range comprising models C20, C27 and C41, the machine is entirely automatic in its operation, and the time-cycle control system permits the operating cycle of the machine to be varied at will to allow off specification materials to be handled satisfactorily. It is also claimed that excellent washing can be obtained and a higher purity of product than is possible with the batch-type machine. Also, since the discharge and feed arrangements of the *Super-D-Hydrator* are automatic, the equipment is made in *Vaportite* form with a consequent reduction in solvent loss, a reduction in the hazard of handling dangerous materials and an improvement in working conditions.

AUTOMATIC CONTROL

A new **measurement and control** system to be exhibited by Hartmann & Braun A.G. uses a direct current of 0 to 20 milliamp., with unit construction. Indication and recording are effected with standard 20-milliamp. d.c. instruments, and lead resistances of up to 5,000 ohms are unimportant, so that readings can be transmitted over considerable distances. Ordinary commercial long-life valves, connected in parallel, are used, so that interruptions due to failure of the electronic circuitry are precluded. Simple ' plug-in ' connections make interchange of components easy and quick.

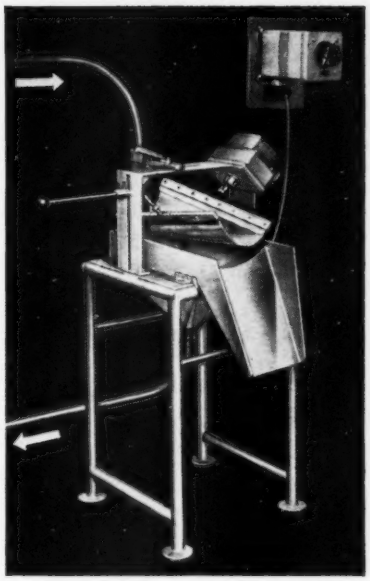
For electrical control a further two electronic units are provided (proportion and time elements) with magnetic output amplifiers and electric power controls producing torques of 12, 50 and 100 m.kg. (84, 350 and 700 ft.-lb., approximately). A pneumatic controller is available with a delivery pressure of 0.2 to 1 kg./sq.cm. (2.8 to 14 p.s.i.).

These instruments are expected to find wide use in industry for measuring flow, pressure, mass and temperature, and for controlling boilers, fractionating columns, and physical and chemical processes.

Continuous supervision of viscosity is indispensable in both maintaining the quality of liquids and plastics and in ensuring their effective utilisation in technical processes. The H. & B. rotary **viscometer,** with electric torque balancing, was developed for this purpose; it should not be confused with rotary viscometers for individual samples. Advantages claimed for the system are: high accuracy ($\pm 0.25\%$); wide range (0 to 5,000 poises); easy interchange of components, with plug-and-socket type connections; minimal maintenance; easy handling; resistance to tropical conditions and a high standard of safety.

A further exhibit of this company will be the Neudert-Röpke automatic titrating equipment by means of which the time-consuming operations of adding the titrating reagent and drawing the *p*H/volume curve at the same time are taken care of automatically, so that the operator's work is limited to the necessary preparation for the titration. The equipment consists of a laboratory *p*H meter and the automatic titrator (dispenser, controller and recorder).

Using this system, automatic titrations to displaced end-points can be carried out, as well as ' dead-stop ' titrations (*e.g.* Karl-Fischer), and amperometric and polarographic titrations and measurements (current/potential diagrams). Two dispensing devices can be fitted to the controller, one being prepared whilst the other is in use, or they may be coupled in electrical opposition for differential potentiometric titrations. One multipole contactor suffices for making the various connections. (Hall 1, Stands H10-11.)

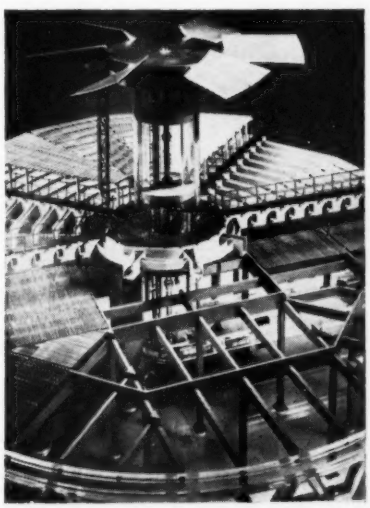


' Rhewum ' sonic filtration machine.

Compact and convenient **instrumentation** will be demonstrated by J. C. Eckardt A.G. In case of air failure in the pneumatic transmission of measurements the firm provides instruments with emergency indicators. For transmission of measurements over great distances, electric transmitters give readings without time lag. Remote-reading instruments using resistance transmitters are supplied in explosion-proof form. A compensation transmitter converts readings into a milliampere current, giving either linear or root-extraction values. The current can be transformed into corresponding pneumatic pressure in the control room by means of a compensation-transducer.

Compact multiple indicators and recorders will be shown, with attachments for electric remote operation of pneumatic actuators of the process controls. A multiple selector for several remote readings will also appear.

For measuring gas flow under variable conditions of pressures and temperatures, a transducer transmits an integrated current proportional to the gas flow. (Hall 1, Stand H15.)



Balcke cooling-tower mechanism.

The recently introduced *Commander KE* high-speed electronic self-balancing **temperature recorder** will be among the exhibits of George Kent Ltd. By virtue of the modular construction and rationalised design of the *Commander* range, the user can, if he wishes, build up his own range of instruments or add to those already in use such units as improved techniques or additional plant demand.

Two more models in the same range — a flow recorder-transmitter (pneumatic) and a flow-recorder-controller—will demonstrate flow-ratio control using water-flow lines. The desired-value setting of the controlling instrument is adjusted by the pneumatic signal from the transmitter through a *Remoset* (remote-control setting and ratio device) in the controller—the controller's output then actuating a diaphragm control valve in the flow line. A further instrument in the *Commander* range that can be seen as a working model is a combined flow, pressure and temperature recorder.

In the quality-control section of the display, oxygen analysis will be demonstrated by a *Multelec* **oxygen recorder** and a Kent paramegnetic oxygen analyser. Also in this section is a single-point *Universal* *p*H recorder together with tank- and flow-type *Universal* *p*H primary elements (glass electrode).

An interesting demonstration of pressure recovery during flow measurement will be given by a special U-tube

Continuous solvent recovery plant by Sutcliffe, Speakman.

comparison unit consisting of miniature *Dall* and venturi flow tubes and an orifice fitting. A wooden model of a 6-in. *Dall* tube for flow measurement will also be exhibited. Kent mechanical meters, also to be on view, include a rotary-piston domestic water meter, a low-flow oil meter, and a water meter for industrial supplies. This display also includes a sectioned rotary-shunt steam meter.

In addition, Kent unit draught gauges and an air-operated power cylinder will be on display, together with orifice fittings (for measuring flows in small pipelines). (Courtyard, Stands 44 and 45.)

Equipment on show by Siemens & Halske A.G. will include the *Teleperm* and *Telepneu* electrical and pneumatic **control systems** which are designed on the unit principle. A novel 'two-out-of-three' automatic control system for process and nuclear energy plants is claimed to ensure complete reliability by comparing signals received from three independent indicating devices, and only registering values which are in complete agreement on at least two circuits. Defective components can thus be easily identified and replaced. All-electric *Teleperm* controllers for process plants can register temperature, pressure, differential pressures, flow rates, and gas analyses. These controllers can use the type S regulator, which is a continuously operating electro-mechanical amplifier with combined pulse length and pulse frequency modulation. Another type of control mechanism provides for a continuous adjustment of the control equipment. This equipment, designed on the unit principle, may be used with the *Telepneu* pneumatic system through suitable transducers.

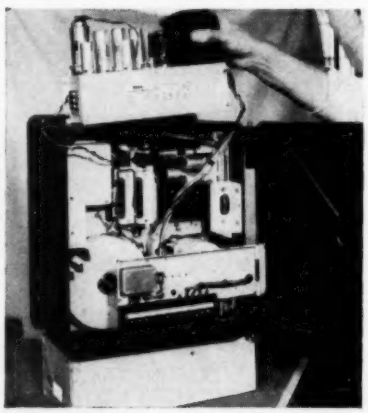
Nuclear physics is well catered for with neutron flux measuring chambers, gas analysers, and reactor control rod drives. A model of a control unit for a heterogeneous heavy water reactor is on show. Monitoring equipment of all types includes a sensitive counter for cooling water protection. Data processing equipment includes land line repeaters and teleprinters, analogue (digital converters, converters to punched card systems) and various types of indicating and recording devices, including multipoint (2, 3, 6 and 12 coloured) recorders.

A rapid-response radiation pyrometer (*Ardofot S*) with a germanium photodiode, and the more conventional *Arnox* multi-thermocouple radiation pyrometer is suitable for use with furnaces, rolling mills, etc.

Gas analysis equipment includes a differential thermal conductivity cell and catalytic combustion oven to measure D_2 in He, and HD in H_2, for nuclear physics installations. LiCl moisture meters are available for the measurement of absolute and relative humidities, and electrical conductivity cells are available which can measure salt concentrations over concentration ranges of from 0 to 0.3 mg./l. NaCl to 2,000 to 7,000 mg./l. NaCl.

In addition, standard types of instruments for the measurement and control of pressure, flow, *p*H, mechanical force and chemical composition will be shown.

Taylor Controls Ltd. will be showing three new **instruments,** briefly described in CHEMICAL & PROCESS ENGINEERING for April (page 138). One of these is a *Transcope* recorder, available with electric or pneumatic integral alarms and a complete cascade system. It allows for front control settings while still recording and is designed to receive any Taylor plug-in controller. The instrument is remarkable for the number of features it includes in such a small panel space. Accompanying it on the Taylor stand will be the *Transcope* controller.



Withdrawing amplifier from rear of George Kent's new 'Commander KE' temperature controller.

The same company's new potentiometer transmitter will also appear at the Achema. Features include an interchangeable, plug-in, printed circuit; one standard amplifier; continuous vernier zero or suppression adjustment; and either up-scale or down-scale thermocouple burnt-out protection. (Hall 1, Stands A16—17.)

ELECTRICAL EQUIPMENT

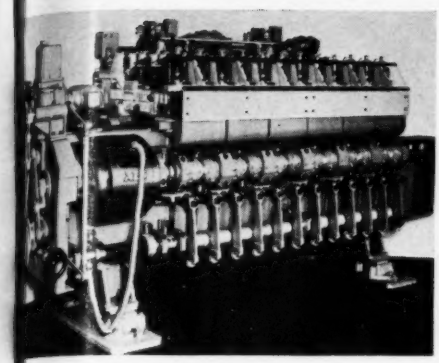
A range of electrical equipment will be shown by Allgemeine Elektricitäts-Gesellschaft (A.E.G.), who include among their specialities flameproof motors, flameproof L.T. switchgear, mechanical rectifiers and turbo-compressors.

A.E.G. claim success in building **mechanical rectifier plant** for electrolytic purposes up to voltages of 1,200 volts d.c. and point out that, although the difference of efficiencies of mechanical and mercury-arc rectifiers is less striking in the upper range of output voltage, the savings due to the inherently lower losses of the mechanical rectifier may, nevertheless, often prove a decisive point in its favour. With the development of the six-phase bridge circuit connection, the company claims to have laid the foundation for the building of mechanical rectifiers for all voltages met with in present-day electrolytic practice.

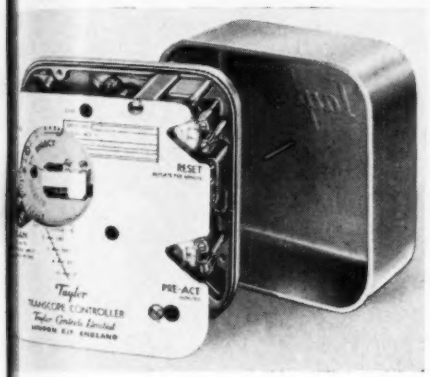
As proof of the trustworthiness of mechanical rectifiers, particularly for high voltages, the case is cited of a rectifier machine working at 700 volts d.c. which attained a life of one year without replacements. Another interesting installation, consisting of 12 units with an aggregate rating of 150,000 amp. supplied to common busbars, is to work at 680 volts d.c. This large installation is destined for an aluminium plant in Norway.

A feature of the A.E.G. rectifier is that, instead of being encased in close-fitting panelling there is a roomy housing through which entry can be gained by a door for maintenance work. The contacts are arranged in a row with generous insulating clearances between them, and they can be observed at a glance through a plastic window in the housing.

For fine voltage control between the tap positions of the tap-changing transformer usually employed in electrolytic plant and for starting up an electro-



Mechanical rectifier equipment by A.E.G.



Taylor 'Transcope' controller.

lytic process, a system of magnetic and mechanical downward voltage control is employed. (Hall 1, Stands D5—7, E5—7; Hall 3, Stands B19—20, C19—20.)

ATOMIC ENERGY

The United Kingdom Atomic Energy Authority will have an area of about 1,400 sq. ft. devoted to the industrial applications of **radioisotopes.** The stand will have working models of some of these applications, such as thickness gauging, the measurement of liquid levels inside containers, industrial radiography and tracer techniques generally.

In addition there will be an exhibit describing the work which is being carried out at the Wantage research laboratories on the application of radiation from large 'waste product' sources in industrial chemistry and such applications as the preservation of food from attack by insects and bacteria. This work has an important future application inasmuch as vast quantities of fission products will become available from the operation of the power stations of the nuclear power programme.

LABORATORY APPARATUS

An **interference microscope** to be shown, designed for transmitted light, enables very small phase changes caused by a specimen to be seen and measured. From these measurements, any change of optical thickness protein concentration in living cells can be calculated and other information derived. The instrument also makes visible specimens which do not absorb light and would otherwise be invisible without staining. It will appear on the stand of C. Baker of Holborn Ltd., as will also another interference microscope which is for opaque objects and measures deviations from a perfect surface finish. It is useful in research fields where surface finish phenomena are important. (Hall 7, Stand A35.)

Apparatus for the testing of lubricating greases and the storing stability of fuels, as well as calorimeters for the determination of specific warmth, heat tones of mixtures, hydration warmth of cement, etc., and apparatus for the testing of explosives, will be featured by Julius Peters. Newly developed is the photo-chronograph, which takes photographs and measures the detonation-velocity of quick combustion processes and detonations which are combined with light appearances. The apparatus works with a film velocity up to 200 m/sec. (Hall 7, Stand D7.)

New products to be exhibited by H. Reeve Angel & Co. Ltd. will include completely new types of modified cellulose ion-exchange **papers** and powders, a new 100% glass-fibre filter paper which may also have application in chromatographic and electrophoretic work and some new types of specially prepared and purified papers mainly for chromatographic use. (Hall 6, Stand D2.)

A display devoted entirely to *Analmatic* equipment for the automation of routine **analytical work,** and illustrating the applications of this system for process control, automatic determination of moisture, addition of reagents to samples in test tubes, transfer of aliquots, and continuous analysis of uranium in process streams, will be featured by Baird & Tatlock Ltd. (Hall 6, Stand D3.)

With their display of metering and volume pumps and valves, Milton Roy of Philadelphia will exhibit a new *Quantichem* **colorimetric analyser.** This analyser continuously performs any colorimetric analysis that does not require boiling or filtration. Ranges include 0 to 5×10^{-8} parts for dissolved silica, 0 to 3×10^{-6} parts for total water hardness and 0 to 1×10^{-4} parts for dissolved iron. It has similar low ranges for dissolved oxygen, residual chlorine, phosphates and sugars. (Hall 1C, Stand B6.)

The new range of Gallenkamp **laboratory ovens** features a new hydraulic thermostat invented specially to meet exacting requirements for accurate temperature control, with automatic compensation for changes in ambient temperature. Available in three sizes, with or without mechanical convection, the ovens have a temperature range up to 200°C., reached from ambient within 65 min.

With grey duotone enamel exteriors and stainless-steel interiors and fittings, the incubators are similar except for the addition of an internal, toughened-glass door and concealed controls. They operate between ambient temperature and 70°C., with a maximum variation of ± 1°C. at 37°C. and maximum fluctuation of 0.1°C.

The semi-micro ebulliometer, another recent introduction, was designed for rapid and accurate determinations of molecular weights of organic solids and liquids up to about 2,000 and accurately measures the elevation of boiling point of a solvent on the addition of a solute. (Hall 10, Stands B4, C4.)

As an example of the work of the technical and scientific **research** organisations, as opposed to the commercial firms, there will be some exhibits by the Institut für Chemische Technologie, der Rhein-Westfälischen, Aachen. A newly developed calorimeter for the evaluation of brown coal has a relative error of approximately 0.8%. A process for the electro-chemical synthesis of sebacic acid from the mono-methyl ester of adipic acid is carried out by the intermediate production of the dimethyl ester of sebacic acid. The ester, sparingly soluble in water, is continuously withdrawn at a rate which depends on the *p*H of the mixture.

An apparatus using radioactive substances provides a rapid and precise evaluation of ion exchangers. In the field of chromatography, absorptive filtration allows the large-scale separation, by elutriation, of migratory and adsorbed constituents. An apparatus for estimating the heat of coking is based on measurement of differences of temperature.

In the study of high-pressure processes, the Institute has brought the synthesis of benzo-nitrile to the production stage, and another process to produce azo-benzene from nitro-benzene by reduction with CO is under investigation. An apparatus has been developed for the study of organic vapour pressures.

A method has been evolved for the radiological estimation of the hydrogen content of gas mixtures by measurement of beta absorption.

WE SHALL BE THERE, TOO!

CHEMICAL & PROCESS ENGINEERING

will be on Stand A10 in Hall No. 6. All visitors will be given a cordial welcome.

Among the spectroscopic and crystallographic instruments exhibited by Unicam Instruments Ltd. are three new developments. The S.P. 100 infra-red **spectrometer** is equipped with a new grating accessory which consists of a second monochromator using two gratings (1,500 and 3,000 lines/in.) which, with the rock salt prism monochromator of the basic instruments, forms a double monochromator with high resolution and low stray light, providing double-beam spectra on a linear wavenumber scale over the ranges 650 to 2,150 cm.$^{-1}$ and 2,150 to 3,650 cm.$^{-1}$. The S.P. 900 flame spectrophotometer incorporates a silica prism monochromator (of high light-gathering power) which gives continuous wavelength selection over the whole range of 250 to 1,020 μ. Light from the burner passes through the monochromator on to a detector *via* a 100 c/s. chopper. The detector output is amplified and synchronously rectified and displayed as a direct reading of emission line intensity on a spot galvanometer.

A completely new instrument that will appear on this stand is the S.P. 700 recording spectrophotometer with which transmission or optical density is automatically recorded against wavenumber by a double-beam method in the ultra-violet, visible and near infra-red region. Light from the hydrogen or tungsten lamps passes twice through a *Suprasil* fused silica prism monochromator and is chopped between the passes. Slits are controlled by a servo system which keeps the energy in the reference beam constant. (Hall 7, Stands B22, C22.)

RECENT PUBLICATIONS

Electrical precipitators can only operate at maximum efficiency if the gas is uniformly distributed over the cross-sectional area of the electrical fields. In many instances the inlet ducting is such as to prevent adequate distribution unless specific devices are employed to constrain the gas to cover the available electrode area. Long experience has indicated that in many cases it is quite impossible to predict the gas distribution and recourse must be made to scaled model tests using either water or air as the fluid. Such model tests, operated under conditions approximating to dynamic similarity, indicate the design features which must be incorporated in the ducting and precipitator to ensure sensibly uniform gas distribution in the full-scale plant. Devices incorporated in plant design may comprise louvres, splitter plates, perforated plates, banks of tubes or a combination of these. This and much other information on electrical precipitators is included in an illustrated booklet issued by W. C. Holmes & Co. Ltd., P.O. Box No. B7, Turnbridge, Huddersfield.

Fire-resistant fluids. Where hydraulic fluid from a break or leak can spray or drip on to a source of ignition, you cannot afford to take a chance with inflammable fluids. Two water-base, fire-resistant fluids with viscosities that will meet the requirements of most hydraulic systems are discussed in a 10-page pamphlet from the Mobil Oil Co. Ltd., Caxton House, Westminster, London, S.W.1.

Glassware. From Quickfit & Quartz Ltd., of Stone, Staffs., comes a supplement to their catalogue, dealing with open-neck reaction vessels. This supplement lists additions to the range of standard parts, including flasks and lids with flat-flange connections and an improved stirrer design.

Pneumatic handling. The various applications of pneumatic handling equipment, *e.g.* the bulk handling of bulk chemicals and raw materials, the discharging of ships and barges, coal handling, etc., are discussed in an illustrated booklet issued by Simon Handling Engineers Ltd., of Cheadle Heath, Stockport, Cheshire.

Level switches. The manufacturers of *Mobrey* magnetic level switches, Ronald Trist & Co. Ltd., of Bath Road, Slough, state that they have over 100 different types of glandless switches available for use in almost any liquid. A publication which they have just produced gives brief details of some of the basic types. Glandless construction makes the switches particularly suitable for operation under pressure or vacuum without fear of fluid leakage.

Concrete advice. A new, 32-page booklet, intended for the maintenance engineer and produced by Lafarge Aluminous Cement Co. Ltd., 73 Brook Street, London, W.1, discusses the uses of *Ciment Fondu* in carrying out urgent concrete work and in making refractory, insulating and corrosion-resisting concretes.

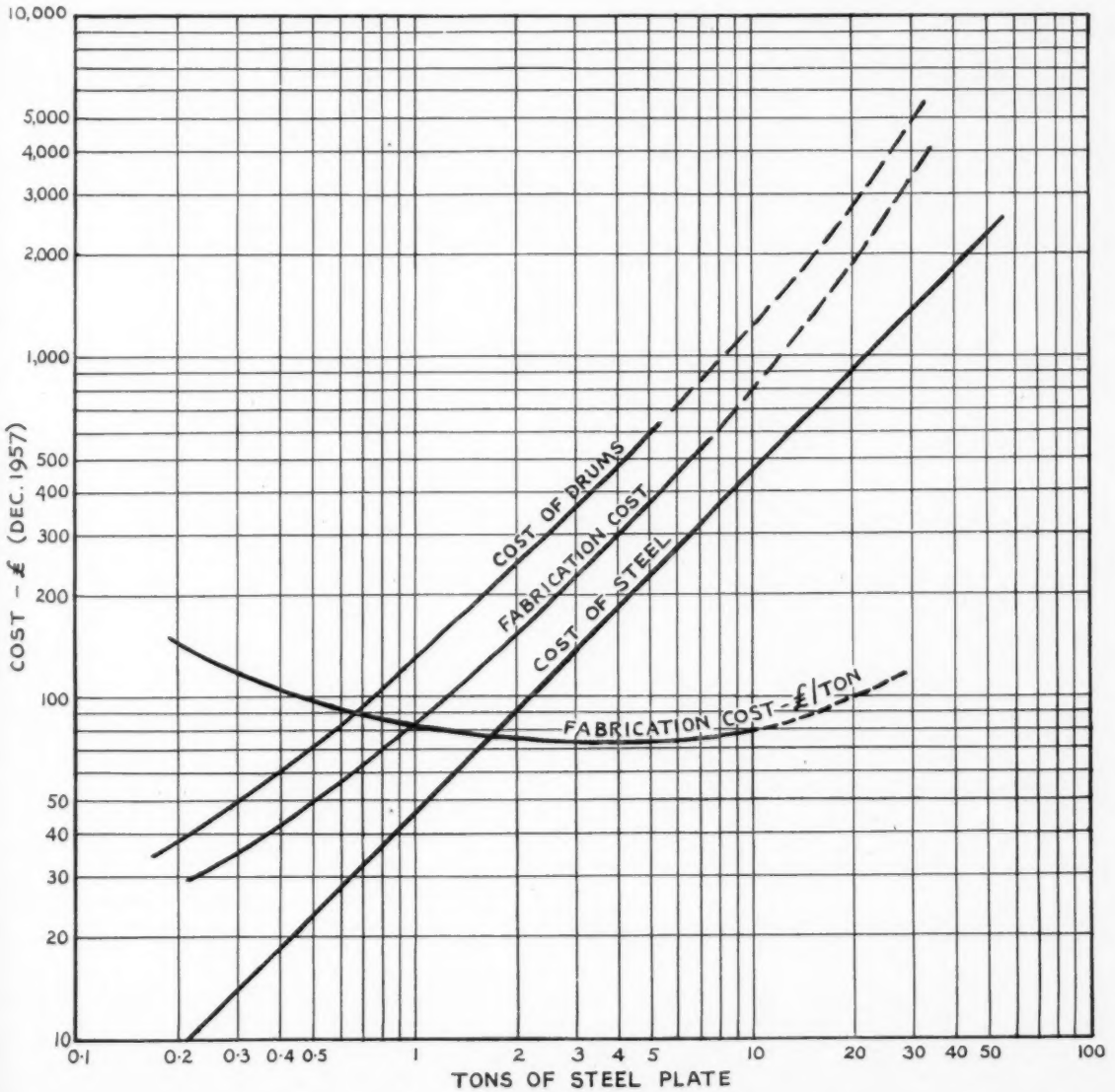
Filter media. Although the cost of synthetic fibre fabrics for filtration purposes is usually higher than the natural fibre, longer service, better performance and higher production offset this cost difference. The physical and chemical properties of synthetic fibre filter fabrics allow filtration operations to be carried out at elevated temperatures and in the presence of corrosive chemicals; also allowing filtration operations which were never before possible. These points are made in a brochure issued by the textile fibres department of E. I. du Pont de Nemours & Co., Wilmington 98, Delaware, U.S.A., the object of which is to assist engineers and designers in the industrial applications of synthetic fibres.

Globe valves are the subject of an illustrated brochure published by Bell's Asbestos & Engineering Ltd., of Slough. The brochure is one of a series describing the *Bestobell* range which also includes parallel slide and gate valves, water gauge fittings and cocks, reducing and relief valves, lubricated plug valves and hydraulic control and stop valves.

Costs of Horizontal, Mild-steel Drums with Domed Ends

THE accompanying graph incorporates the costs of a number of mild-steel drums. The drums in question range in capacity from 250 to 12,000 gal. and wall thicknesses range from $\frac{3}{16}$ to 1 in. The costs are plotted against the weights of the drums, which range from 0.2 to 30 tons.

The cost of a given drum will be the sum of the materials cost, the labour cost and allowances for overheads and profits. On the graph we



show the materials cost and the 'fabrication cost' which was obtained by difference and which includes, therefore, all costs other than materials cost.

A fourth curve shown on the graph is derived from the fabrication cost. It shows the fabrication cost per ton of steel used. As a first approximation it may be assumed that man-hours, machine times, etc., will be very similar for similar jobs, *e.g.* rolling and welding of a vertical tank or a heat-exchanger shell. This curve will then be useful for approximating equipment fabricated by similar operations.

In the case of a horizontal drum the cost may be read directly from the curve once the weight of the shell has been calculated.

To save some calculation time Tables 1 and 2 give the weights of horizontal, mild-steel, welded storage tanks. These are standard sizes and the dimensions shown are those of British Standard 2594 : 1955.

£ s d

CHEMICAL PLANT COSTS

Cost indices for the month of March 1958 are as follows:

Plant Construction Index: 172.0
Equipment Cost Index: 163.6
(June 1949 = 100)

£ s d

Table 1. Dimensions,* Capacities and Approximate Weights of Horizontal Storage Tanks in Mild Steel with Dished, Unflanged Ends

Gross capacity	*Nominal inside diameter*	*Nominal length of shell*	*Maximum overall length*	*Thickness*		*Weight*	*Thickness*		*Weight*	*Thickness*		*Weight*	*Thickness*		*Weight*
				Shell plate	*Dished ends*		*Shell plate*	*Dished ends*		*Shell plate*	*Dished ends*		*Shell plate*	*Dished ends*	
Imp.gal.	*ft. in.*	*ft. in.*	*ft. in.*	*in.*	*in.*	*tons*	*in.*	*in.*	*tons*	*in.*	*in.*	*tons*	*in.*	*in.*	*tons*
256†	3 6	4 0	4 6¾			0.217			0.239			0.289			
316†	3 6	5 0	5 6¾			0.255			0.277			0.340			
376	3 6	6 0	6 6¾			0.292			0.314			0.389			
436	3 6	7 0	7 6¾			0.330			0.352			0.440			
420	4 0	5 0	5 8¾			0.301			0.330			0.401			
577	4 0	7 0	7 8¾			0.387			0.416			0.516			
				3/16	3/16		3/16	1/4		1/4	1/4				
530†	4 6	5 0	5 8¾			0.351			0.387			0.468			
629	4 6	6 0	6 8¾			0.399			0.435			0.532			
827	4 6	8 0	8 8¾			0.496			0.532			0.661			
1,026†	4 6	10 0	10 8¾			0.592			0.628			0.789			
1,032	5 0	8 0	8 10¾			0.565			0.610			0.753			
1,277	5 0	10 0	10 10¾			0.672			0.717			0.896			
1,540	5 6	10 0	10 10¾			1.006			1.061			1.258			
1,501	6 0	8 0	9 0¾			0.948			1.014			1.185			
1,854	6 0	10 0	11 0¾			1.119			1.185			1.399			
2,588	6 0	14 0	15 0¾			1.462			1.528			1.828			
2,278	6 6	10 6	11 7			1.282			1.359			1.603			
2,588†	6 6	12 0	13 1			1.421			1.498			1.776			
2,542†	7 0	10 0	11 3¼			1.357			1.446			1.696			1.785
3,022†	7 0	12 0	13 3¼			1.557			1.646			1.946			2.035
3,501	7 0	14 0	15 3¼			1.757			1.846			2.196			2.285
4,100	7 0	16 0	17 9¼			1.957			2.046			2.446			2.535
5,059	7 0	20 6	21 9¼			2.407			2.496			3.009			3.098
				1/4	1/4		1/4	5/16		5/16	5/16				
4,157†	7 6	14 6	15 9¼			1.965			2.068			2.456			2.559
4,130	8 0	12 6	13 11¼			1.895			2.012			2.369			2.486
5,225	8 0	16 0	17 5¼			2.295			2.412			2.869			2.986
													5/16	3/8	
5,050†	8 6	13 6	15 1½			2.167			2.299			2.709			2.841
6,111†	8 6	16 6	18 1½			2.531			2.663			3.164			3.296
8,055	8 6	22 0	23 7½			3.199			3.331			3.999			4.131
10,176	8 6	28 0	29 7½			3.927			4.059			4.909			5.041
6,297†	9 0	15 0	16 9¾			2.504			2.648			3.130			3.274
8,279	9 0	20 0	21 9¾			3.146			3.290			3.933			4.077
12,243†	9 0	30 0	31 9¾			4.433			4.577			5.541			5.685

* Dimensions from British Standard 2594 : 1955. † Preferred tank sizes.

CPE KEEPS ABREAST OF COST DATA

Articles on costs published in previous issues include Introduction to C.P.E. Cost Index for Construction of Chemical Plant (Jan. 1957), American and British Plant Cost Indices Compared (Feb. 1957), Introduction to Cost Index for Chemical Process Equipment (April 1957), Building Costs in the Chemical Process Industries (May 1957), Personnel Requirements (June 1957), Summary of Cost Data for 1957 (March 1958).

Table 2. Dimensions, Capacities* and Approximate Weights of Horizontal Storage Tanks in Mild Steel with Dished, Flanged Ends

Gross capacity	Nominal inside diam.	Nominal length of shell	Maximum overall length	Thickness: Shell	Thickness: Dished ends	Weight	Thickness: Shell	Thickness: Dished ends	Weight	Thickness: Shell	Thickness: Dished ends	Weight	Thickness: Shell	Thickness: Dished ends	Weight	Thickness: Shell	Thickness: Dished ends	Weight
Imp.gal.	ft. in.	ft. in.	ft. in.	in.	in.	tons	in.	in.	tons	in.	in.	tons	in.	in.	tons	in.	in.	tons
290	3 6	4 0	4 9½			0.222			0.247	¼	¼	0.297						
330	3 6	5 0	5 9½			0.230			0.285	¼	¼	0.348						
390	3 6	6 0	6 9½			0.297			0.322	¼	¼	0.397						
450	3 6	7 0	7 9½			0.335			0.360	¼	¼	0.448						
440	4 0	5 0	5 11⅛			0.306			0.340	¼	¼	0.411						
595†	4 0	7 0	7 11⅛			0.392			0.426	¼	¼	0.526						
555†	4 6	5 0	5 11¾	3/16	3/16	0.357	3/16	¼	0.398	¼	¼	0.479						
654	4 6	6 0	6 11¾			0.405			0.446	¼	¼	0.543						
852	4 6	8 0	8 11¾			0.502			0.543	¼	¼	0.672						
1,050†	4 6	10 0	10 11¾			0.598			0.639	¼	¼	0.800						
1,062	5 0	8 0	9 1½			0.572			0.622	¼	¼	0.765						
1,306	5 0	10 0	11 1½			0.679			0.729	¼	¼	0.908						
1,575	5 6	10 0	11 1½	¼	¼	1.019			1.077			1.274						
1,542	6 0	8 0	9 3½	¼	¼	0.962			1.032			1.203						
1,894†	6 0	10 0	11 3½	¼	¼	1.133	¼	5/16	1.203	5/16	5/16	1.417						
2,598	6 0	14 0	15 3½	¼	¼	1.476			1.546			1.846						
2,330†	6 6	10 6	11 9¾	¼	¼	1.297			1.378			1.622						
2,640	6 6	12 0	13 3¾	¼	¼	1.436			1.517			1.795						
2,605†	7 0	10 0	11 6			1.374	¼	5/16	1.467			1.599			1.711			1.810
3,084	7 0	12 0	13 6			1.574	¼	5/16	1.667			1.799			1.967			2.060
3,565†	7 0	14 0	15 6			1.774	¼	5/16	1.867			1.999			2.217			2.310
4,165	7 0	16 0	18 0			1.974	¼	5/16	2.067	½	⅜	2.199			2.467			2.560
5,123	7 0	20 6	22 0			2.424	¼	5/16	2.517			2.609			3.030			3.123
4,203	8 0	12 6	14 2	½	¼	1.914	¼	5/16	2.036			2.155	5/16	5/16	2.393	5/16	⅜	2.515
5,299	8 0	16 0	17 8			2.314	¼	5/16	2.436			2.555			2.893			3.015
6,393†	9 0	15 0	17 0½			2.525			2.675	¼	⅜	2.823			3.157			3.306
8,375	9 0	20 0	22 0½			3.167	¼	5/16	3.317	½	⅜	3.465			3.960			4.109
12,340†	9 0	30 0	32 0½			4.454			4.604	½	⅜	4.752			5.568			5.717

* Dimensions and capacities from British Standard 2594 : 1955.
† Preferred tank sizes; preferred thicknesses are shown in heavy frames.

Fuel economy cuts costs in fertiliser plant

An example of savings achieved through attention to fuel economy is provided by an oil-fired rotary fertiliser drier operated by Robert Stephenson & Son Ltd., Beverley, which as a result of a test carried out in May 1957 had its combustion chamber redesigned while ducting was installed to recirculate gases from the kiln exit fan to the inlet.

Before these adjustments were made fuel oil consumption was 6.25 gal. per ton of product. This was reduced to 4.4 gal. In December 1957 a second survey was made which showed that, by insulating the ducts and using preheated air, consumption could be further reduced to 3.8 gal. per ton of product.

Apart from the oil savings, it is interesting to note that the quality of the product has also improved so that an unexpected bonus has come from the improved fuel efficiency.

This is one of a number of 'success stories' reported by the National Industrial Fuel Efficiency Service.

Big new data-handling system for atomic energy plant

A data-handling system which is expected to be the largest in Europe is planned for the United Kingdom Atomic Energy Authority's plant for gaseous diffusion of uranium hexafluoride at Capenhurst.

The contract has been awarded to Sunvic Controls Ltd. and there will be eight units each capable of scanning 260 points measuring process gas, gland and motor bearing temperatures, as well as cooling water temperatures, motor currents and voltage. Each unit will monitor signals from a group of four 'cells.' In a central control room will be equipment for printing, on demand, a tabulated log showing the value at all measuring points on any one of the 32 cells, the cell identification and the time of scanning. Any point exceeding predetermined limits will be shown on the log sheet in red. Fitted to each of the eight logger units will be an alarm printer to record the time, identification and value when any point goes 'off normal' or returns to normal; once again 'off-normal' values will be shown in red, and there will also be a code to show whether a point is high, low or defective.

Two mobile print-out units will also be supplied. These will enable a complete log to be obtained at any time, for any cell.

Utilisation of contaminated acid from the normal processes of refining benzole and similar hydrocarbons is made possible by a new process developed in the United Kingdom. This makes it possible to reclaim the acid in a relatively pure form suitable for many commercial processes. The resinous matter is also brought into a more amenable form, even to the possibility of utilisation. It is also stated that the recovered acid can be employed in the manufacture of sulphate of ammonia without risk of trouble.

Recovery of Waste Acid from Benzole Refining Plants

THE new process for the recovery of waste acid from benzole refining plants was developed as a result of observations made on the reactions of coal gas or coke-oven gas when in contact with sulphuric acid at various strengths. If coal gas in the laboratory is passed through sulphuric acid of, say, 50% concentration, cold, there is slow growth of a brown solid deposit, although the character of the gas is apparently unchanged. It was found that this was substantially the same reaction as occurs when crude benzole is agitated with sulphuric acid for the purpose of reducing its sulphur content and improving its purity and stability. In the experiments on gas, it was found that the gum or resin so produced was freely soluble in phenolic substances, and that the growth of the solid deposit was stopped when they were present.

Assuming a similar character for these resins to those which are produced by the refining of benzole, it appeared that phenols would have a strong solvent property for the resins from crude benzole which are insoluble in sulphuric acid. A point of technical interest is that a number of benzole refiners have improved the separation of the resins from the acid by agitating the mixture with coal-tar creosotes, which normally contain 10 to 30% of phenolic substances, and it is found that the success of this treatment is progressively enhanced by larger proportions of phenol homologues.

Basic treatment

However, such treatments, although they may render the ultimate disposal of the acid rather more convenient, do not bring it into a state which could be recognised as reasonably pure, even in a comparatively dilute condition as regards water content. The important second step is, therefore, to select a phenolic reagent which will intensify the treatment and give accurate and clean separation. The normal mixture of the three cresols, after distillation, was found to satisfy this requirement very well, and sulphuric acid of a dark and turbid character can be clarified to almost any desired extent by extraction with this reagent.

At a stage not difficult to identify, it becomes quite suitable for the manufacture of sulphate of ammonia, which is a process normally going on in most carbonising plants. Any difficulties of clogging of saturators by dirty acid are entirely eliminated, and the ammonium sulphate product is of technical purity.

It should be noted that the normal proportions of waste sulphuric acid from benzole refining, to the demands of the sulphate of ammonia plant, leave the recovered acid in a very small proportion, but nevertheless sulphate of ammonia made by the recovered acid alone fulfils the technical requirements. Consequently, the overall make of sulphate is not contaminated by the recovered material, nor does the relatively low concentration of the latter upset the balance of the sulphate plant itself.

Nevertheless, there are a number of benzole refineries which cannot absorb the waste acid in other processes, such as the manufacture of sulphate of ammonia. There is, therefore, an attraction in bringing back the sulphuric acid into a reasonably clean and concentrated form, which could be made marketable outside the works of its origin. This has been solved in some cases by an intensive extraction treatment, plus reconcentration in a newly devised apparatus, employing temperatures within the range of the average boiler steam.

Where it is desired to bring sulphuric acid back to high concentrations, say, of the order of 75% or upward, the reconcentration phase has to be carefully handled to avoid decomposition of traces of organic matter still left in the acid, and some dosing with oxidising agents has been found beneficial. These should preferably be such as will not leave mineral salts dissolved in the recovered acid.

Reverting to the treatment of the crude acid and resin mixture, other refiners have preferred to break down this mixture by agitation with cold water, hot water or steam. Weak acid derived by this treatment submits to the refining process described above with some minor differences of quantities involved.

Reagent recovery

The mixture of the three cresols is a reagent of such cost that its immediate recovery is attractive. According to the full scheme developed by W. C. Holmes & Co. Ltd., the cresol plus resin mixture is to be redistilled in acid-proof apparatus, using inert gases as the vehicle for distillation, and again at temperatures available from ordinary boiler steam. This recovered cresol immediately goes back into the process, and allows the plant to be

devised as a continuous cyclic treatment without carrying large stocks of any reagents.

According to general practice in benzole refining plants, the crude acid may contain pyridine, which occurs therein by mixing the preliminary acid wash with the true refining wash. Pyridine in the acid ultimately finds its way into the cresol mixture and it is preferable to avoid its presence if possible. It can, however, be dealt with should it be necessary to leave it in at the preliminary stages.

It is also preferable to avoid admixture with neutralising liquids such as soda washes, because the sodium salts naturally remain in the acid and represent impurity therein.

A comprehensive treatment such as has been described should be very welcome to those conducting the operation of benzole refining on any scale, and to local authorities who have quite rightly taken an unfavourable view of partial treatments hitherto practised, though withholding firm action when it could be stated that methods for satisfactory elimination of such a nuisance were not yet available.

Cyclic process

The plant as described in the provisional specifications, Nos. 34649/56 and 32269/57, is designed to take sulphuric acid at concentrations of, say, 30 to 60%, delivered from steaming stills or oil agitation vessels as normally employed in the preliminary treatment. A continuous feed of the acid is thoroughly agitated possibly once or twice in succession with small proportions of the phenolic reagent, the acid being then entirely suitable for sulphate of ammonia manufacture or for reconcentration, the degree of treatment being based on the requirements. The cresol is separated from any entrained sulphuric acid and enters a distilling vessel in which the effective surfaces are of proprietary graphite constructions, being there subjected to heat and contact with inert gases, which pass out through a condenser and return the recovered cresols, etc., to the feed tank. The gases are recycled through the gas pump back to the distilling vessel. A small proportion of resins accumulates in the latter and must be purged off, for example, to crude tar, from time to time.

It is obvious, of course, that the used cresol could be returned to crude tar, and recovered through the ordinary processes of obtaining phenols from the tar distillates, but it is not likely that this roundabout treatment will be preferred.

What, however, is a possibility is that used cresols could be mixed with coal-tar creosote oil for the pretreatment of the acid and resin mixture, and it has been shown that the reinforcing of the phenol content of these coal-tar creosotes, in such preliminary treatment, is helpful. Then the crude mixture of resins, creosote oil and phenols can be effectively treated as crude tar, and recycled with the latter through the tar distilling plant. This has the merit of disposing of the bulk of the resins into the coal-tar pitch. The weight relationship between these resins and the whole of the crude tar is so small that objection is extremely unlikely.

Oils and Fats Technology

(*Concluded from page* 156)

the soap technologist, though not for lack of trying. A recent article[32] described the use of α-sulphostearic and α-sulphopalmitic acids for this purpose. The formula of these is $RCH(SO_3H)CO_2H$, where R is the fatty acid. These materials are stated to be an economical base for producing synthetic detergent bars. The presence of the strong sulphonic and the weaker carboxyl groups enables the formation of a variety of salts which can be acid, basic or mixed. Differences in their water solubility and their high surface activity makes these soaps especially suitable in synthetic detergent bars.

Synthetic detergents from sulphated ethenoxylated tallow alcohols were described by Bistline *et al.*[33] The general formula of these compounds is $R(OC_2H_4)_nOSO_3Na$, where R is the stearic or palmitic acid radical and where n is 2—10. The introduction of two ethenoxy groups improved the solubility of the compounds without loss in detergency compared to the corresponding sodium hexadecyl and oxadecyl sulphates. Two appear to be the optimum and also the most economical number of ethenoxy groups. Ten molecules of ethylene oxide attached to the fatty acid made these products more water soluble but less good detergents. The product made from palmitic acid with two ethylene oxide molecules had the lowest surface tension and the best foaming properties. The product made from stearic acid with two molecules of ethylene oxide was the best emulsifying agent; when the number of ethylene oxide molecules was increased to 10 the product had greater stability to metallic ions and to acid hydrolysis than the other two products.

Books

Of recent books on oils, fats and allied subjects the following deserve special recommendations. Volumes 4 and 5 of the series 'Progress in the Chemistry of Fats and Other Lipids,'[34] covering a wide variety of subjects written by different specialist authors; and Volume 3 of the late Dr. Deuel's[35] work on 'The Lipids.'

In view of the interest in cholesterol, Shopee's[36] book on 'Steroids' is very timely. A French book on tallow and its derivatives[37] and an Italian one on the principal vegetable oils of commerce[38] are useful monographs.

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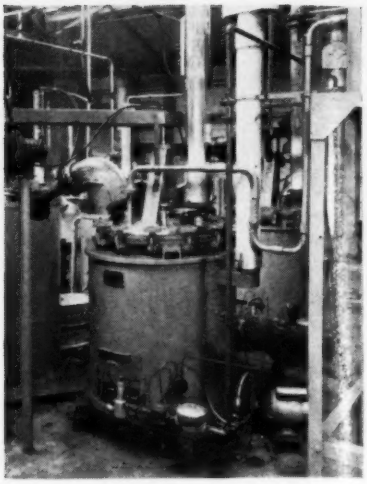
Gas-heated Plant for Insecticide Manufacture



Reaction vessel for fluoroacetamide plant.

FLUOROACETAMIDE is now being prepared in substantial quantities for use in the manufacture of the 1% solution known as *Tritox*, used as a systemic insecticide for the destruction of aphid pests of non-edible plants. Fluoroacetamide itself is a white crystalline solid of mean point 110°C. and is freely soluble in water.

The manufacture of fluoroacetamide is based on the reaction between potassium fluoride and chloroacetamide by refluxing these together in a high-boiling inert solvent, followed by entrainment distillation which removes the fluoride amide from the traction mixture. On cooling the distillate, practically pure fluoroacetamide separates and, after filtration, this is dried at low temperatures and the filtrate is then returned to process; after many re-uses, the solvent may be recovered by distillation in the usual manner.

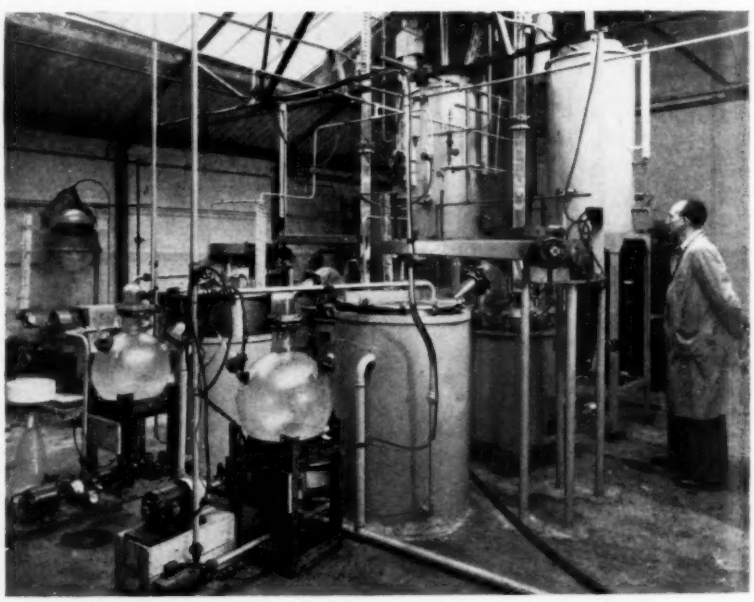
For various reasons, it was decided that the fluoroacetamide plant should be heated by gas and not by steam or electricity. Further, in order to 'automatise' the plant as much as possible, it was decided to make use of special automatic gas-heating apparatus designed by the North Thames Gas Board.

The still consists of a stainless-steel vessel, fitted with agitator and alternative water reflux and air distillation condensers with interlocked controls; an oil jacket is fitted with vent and combined oil filler and overflow. This is heated by automatic gas plant comprising a constant-pressure governor, a rod-type thermostat in the oil operating on a remote relay valve, a *Thermoperl* flame protective device and a clock control; this enables the heating to come into operation and to shut off completely at any predetermined time and to shut down on its thermostat at the desired temperature. In the event of a failure of the pilot flame, the controls automatically set to the safe position. The same controls, with the exception of the rod-type thermostat, are fitted for preheating the solvent in the feed tank which is a 60-gal. steel vessel, lagged; in this case an *Aric* instrument is fitted—this is a thermostat incorporating a dial thermometer which can be pre-set for cut-off at any desired temperature within its range. This device is sensitive to within 1°C. on either side of its setting.

The gas burners in both units consist of a series of Bray burner jets; the former has a gas rate of 80 cu.ft./hr. at 16/10 in. water gauge working pressure and the latter 120 cu.ft./hr.

With these devices it is possible to attain a working temperature of over 100°C. in about 1½ hr. from start-up and to maintain distillation and feed at a rate of 12 gal./hr.; the feed rate is measured and controlled by the use of *Rotameters*.

The North Thames Gas Board collaborated with Dr. M. A. Phillips & Associates, consulting chemists and chemical engineers, in the design of the heating and control equipment. This firm acted as consultants to Associated Fumigators Ltd. whose permission to use this information is gratefully acknowledged.



General view of plant showing arrangement of vessels, etc.

How Granules are Formed

Studies on the mechanism by which spherical granules are formed from moist powdered material in a rotating drum have yielded some interesting results which should be of practical use to designers of equipment for carrying out this operation. At a meeting of the Institution of Chemical Engineers in London recently a paper by Prof. D. M. Newitt, M.C., D.Sc., F.R.S., and Mr. J. M. Conway-Jones summarised recent research at the Imperial College of Science and Technology, and the summary given below includes some extracts from the paper.

'GRANULATION' is often taken to mean a number of unrelated processes and operations in which material is subjected to crystallisation, spray-drying, rolling, extrusion, pressing, etc., in order to convert it into granules. Prof. Newitt emphasised that in the work described the term was limited to the actual operation by which moist particulate material is caused to agglomerate into approximately spherical granules of uniform size; this is usually effected by placing the material in a rotating drum or on a vibrating surface and maintaining the motion until the granules have grown to the required size.

Experiments were carried out using silica sand of known particle-size distribution, moistened with water, the equipment being a horizontal, aluminium drum rotated at constant speed. Preliminary experiments showed that the rate of growth of granules depends on the moisture content of the feed material, the speed of rotation of the drum, the drum loading, and the average size and size distribution of the feed material.

It appears probable that to initiate granulation in fine sand, there must be nuclei with a moisture content of not less than 62% v when

$$\%\, v = \frac{\text{volume of liquid}}{\text{volume of solids}} \times 100$$

A granule containing less moisture is more rigid and, with no excess moisture in the surface, would not, on collision with another granule, be able to coalesce. Such 'surface-dry' granules might, however, be able to hold individual grains of sand if the latter were sufficiently moist to form a 'pendular bond' at the point of contact. Since direct cohesion of two such surface-dry granules cannot take place, the rate of growth will be slow.

To demonstrate further the effect of moisture content on the rate of granule growth, experiments were carried out in which the granules were dried at various rates during granulation. The effect of the drying was progressively to reduce the rate of granule growth and when the average moisture content had been reduced to 62% v very little further growth occurred.

Effect of rotation speed and drum loading

When there was only a small load, so that the tumbling bed was shallow and most of the granules were rolling on the surface of the drum, there was less chance of collisions and the rate of growth was low. A higher loading gave an increased rate of growth but a practical limit was reached with a load of 6.5 lb. For higher loadings the growth rate for the fine sand was extremely rapid due to cascading. A load of 6.5 lb., when the drum was stationary, lay with a maximum depth of 2 in., subtended an angle of nearly 80° at the centre of the drum, and corresponded to 6% of the total drum volume. A standard load of 5 lb. was used in other experiments.

The rate of granule growth, if expressed in terms of drum revolutions, was found to be independent of the speed below 23 r.p.m., although at the lower speeds a greater time was required to produce granules of a given size. There was found to be a limit to the useful increase in the throughput which could be obtained by increasing the drum speed, for eventually a critical speed is approached at which centrifugal force is so great that the contents of the drum are continuously held against the surface and are not able to roll.

A useful criterion is that the tumbling material should not be carried above a line drawn horizontally through the drum axis and it would appear that, in general, a peripheral speed of 120 ft./min. should not be exceeded.

Effect of particle size upon granule growth

The rate of granule growth depends upon the ability of granules to deform and coalesce upon impact with one another. Thus a fundamental variable is the crushing strength of the granules and it can be shown that, among other factors, this is inversely proportional to the average particle size.

Experiments were carried out to indicate that improvements in the production of small granules from the fine sand are obtained when a proportion of a much finer material, mixed fine silt, is present.

Cohesion of granules

In order that further conclusions may be drawn as to the mechanism of granulation, it is advantageous to consider the forces giving rise to the cohesion of moist-sand particles. The magnitude of these forces, which are associated with the surface-tension of the liquid, is determined by the size of the particles, the structure of the granule, and the moisture content.

Three states of water content may be distinguished in a granule. For low moisture content, water is held in the granule as discrete lens-shaped rings at the points of contact of the particles; this is known as the pendular state. At a somewhat higher moisture content the rings coalesce and there is a continuous network of liquid interspersed with air; this is the funicular state. With further increase in the water content the capillary state is reached, when all the pore spaces in the granule are completely filled.

Work carried out indicates that the value of the cohesive stress which is exerted per unit area of a plane in the granules rises steadily as the moisture is removed. It is also indicated that a granule composed of rounded particles will exhibit some cohesive strength even though almost completely dry. For other particle shapes and configurations the increasing pressure-deficiency may not be sufficient to counteract the loss of moisture and the cohesive stress may fall to zero. Examples in this category are cones touching at their apices, and flat plates or spheres separated by a finite distance.

Any removal of water by evaporation or otherwise from a granule containing moisture in the capillary state will produce a curvature of the water-surface in the interstices

of the surface layer of particles and will set up a suction-potential in the granule. This suction will increase rapidly as moisture is progressively removed until a value is reached known as the entry suction, when air begins to enter the pore-spaces between successive layers of particles. Thereafter the suction will remain almost constant until the pendular state is approached.

The entry suction (or suction potential) gives a measure of the resultant forces tending to hold the particles together.

From calculations relating to the maximum strength of granules, it is concluded that the strongest granules from a given material will be produced by compacting the particles to the minimum porosity with sufficient moisture to saturate the voids.

Mode of failure of granules

Observations were made of the way in which failure occurs in granules that are approximately spherical and tested by compression between flat plates, pressure being applied at the poles. The cracks which probably originate inside the granule appear first at a point between the poles and the equator but rapidly spread across the whole meridian. It may be inferred that the application of the load creates hoop stresses in the outer layers of the granule.

The central cylinder between the flat areas at the poles may be considered to be in plastic equilibrium under compressive forces similar to those existing in the familiar triaxial test used in soil mechanics. In this test a cylindrical sample is enclosed in a rubber membrane and stressed axially. The failure load depends on the radial confining pressure and the shear characteristics of the material under test. The cylindrical test specimen has unique properties which allow it to be treated as a problem in plane strain, but for a cylindrical granule it is necessary to account for the influence of the third principal (circumferential) stress on the shear-pattern.

Some conclusions

The experimental results permit some conclusions to be drawn about the mechanism of granule-formation. Initially the feed to the granulator consists of moist particles which have partly coalesced to form loose aggregates, held together by pendular bonds. The granulating action kneads the particles closer together so that the internal pore space in the aggregates is reduced and if the moisture-content is sufficient, the pores may eventually become saturated. An agglomerate with most of its pores filled with water is referred to as a granule.

The properties of a granule differ from those of a pendular-bound aggregate in two important respects. Firstly the maximum cohesive stress within a saturated granular mass, which depends upon the entry-suction, is considerably greater than the cohesion present in the pendular condition. Secondly, it has been shown that the full suction in the pore liquid is not generated until the capillary meniscii are withdrawn into the surface-waists of the granule. It is observed that granules normally appear to have a moist surface and it is only when a load is applied, and the granule is strained, that the moisture is withdrawn into the surface waists. When the granule is not under general stress there is little suction in the pores and the resulting reduction in internal friction allows the granule a considerable degree of surface plasticity. A granule is therefore easily formed into a spherical shape by the rolling action in the granulator, and yet retains a considerable resistance to large stresses which would tend to disrupt it.

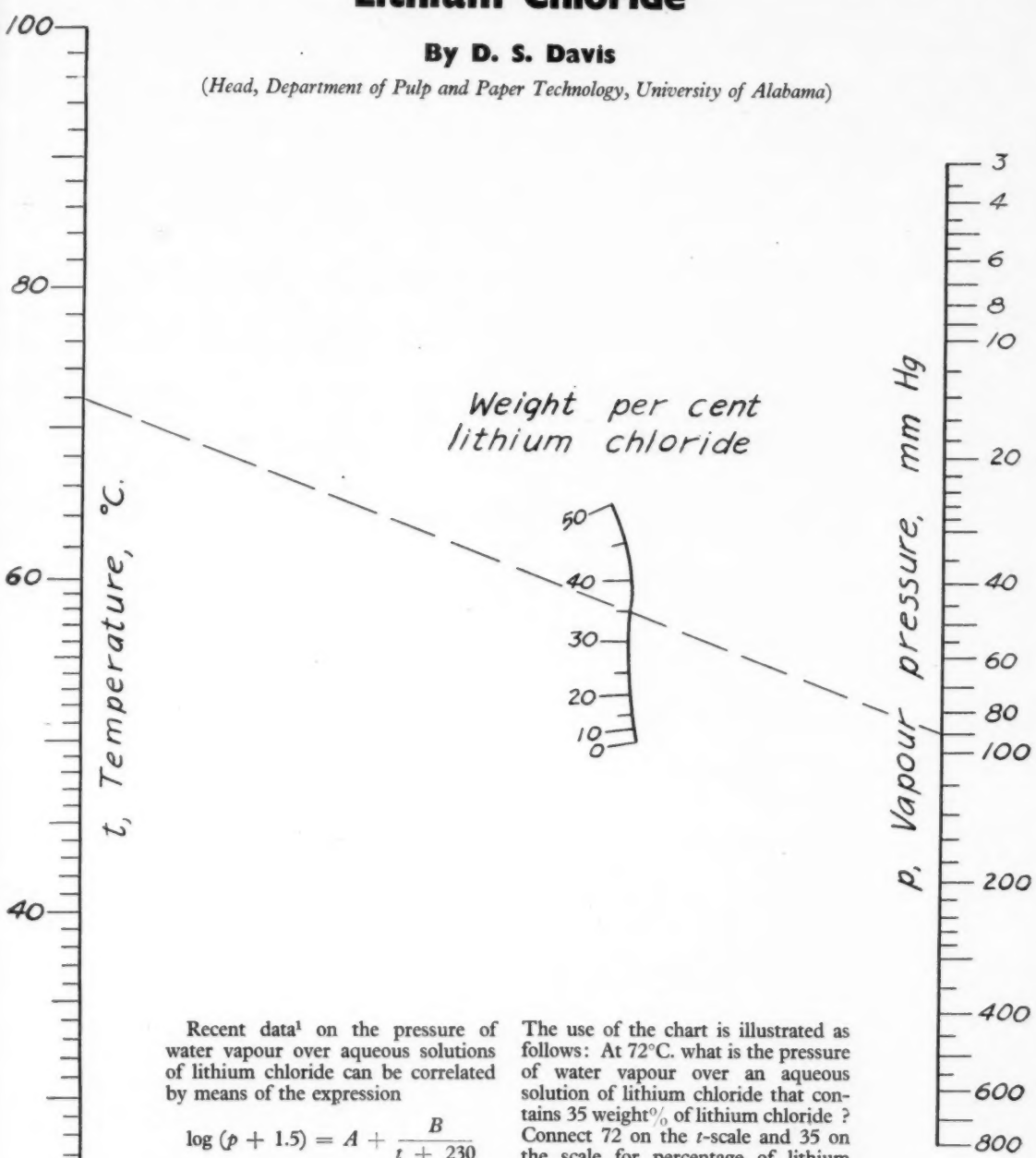
A loose aggregate does not possess the reserve of strength, and from the nature of the pendular bonding it exhibits little surface-plasticity, so that unless it contains sufficient moisture to become saturated, it will tend to have an irregular shape. Such an aggregate, if large enough, may, however, be sufficiently strong to break the true granules and snow-balling will result. In all occasions when this has occurred it was found that the ' lumps ' had 2 to 4% less moisture than the average in the granulator. An important method of reducing lump-formation is therefore to ensure even moisture-distribution in the charge. A relatively high moisture-content also has advantages at this stage of the process for it enables the rapid formation of granules which can quickly break any large, loose aggregates before they cohere.

The granules themselves are not improved by a high moisture content for the moisture prevents their compaction, and it has been shown that the strongest granules from any given material are those with the least porosity. Improvements may, however, be obtained by commencing with a high moisture-content, the excess water being removed during granulation by simultaneous drying.

Nomogram: Vapour Pressure of Aqueous Lithium Chloride

By D. S. Davis

(Head, Department of Pulp and Paper Technology, University of Alabama)



Recent data[1] on the pressure of water vapour over aqueous solutions of lithium chloride can be correlated by means of the expression

$$\log (p + 1.5) = A + \frac{B}{t + 230}$$

where p = pressure of water vapour (mm. Hg), t = temperature (°C.) and A and B depend upon the concentration of the solute.

The utility of the original data is extended considerably through use of the accompanying line co-ordinate chart, which was constructed in accordance with well-known methods.[2]

The use of the chart is illustrated as follows: At 72°C. what is the pressure of water vapour over an aqueous solution of lithium chloride that contains 35 weight% of lithium chloride ? Connect 72 on the t-scale and 35 on the scale for percentage of lithium chloride with a straight line. Extend the line to meet the vapour pressure scale at 90 mm. Hg.

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New Books

Introduction to Thermodynamics

This* is an introductory textbook for students, which assumes no prior knowledge of thermodynamics. While there is no lack of rigour in the theoretical and mathematical presentation of the subject, this is reinforced as much as possible from the physical descriptive point of view, which makes for easy understanding for those approaching the subject for the first time.

The first and second laws of thermodynamics are introduced in the first 11 chapters together with the development of entropy and other thermodynamic functions. The last eight chapters are concerned with the sort of thermodynamics usually found in textbooks of chemistry—they deal, that is to say, with the equilibrium between phases, with chemical equilibrium, and finally with a short account of electrochemistry. Chapters 12 and 13 are concerned with fluid flow. The theory of steady-state flow of compressible and incompressible fluids is developed, and the usual chemical engineering applications to calculation of pressure drop and measurement of flow rate in ducts are dealt with. The above sections of the book appear to be logically and clearly presented.

Chapters 14, 15 and 16 deal with power cycles and refrigeration. These are perhaps a little less interesting than the rest of the book; they are largely descriptive only, and neglect the theory of this part of the subject, which we had hoped to find set out as clearly as that of the other sections of the work. A simple but thorough discussion of the fundamentals of engine theory written from the point of view of the student who has approached thermodynamics by the methods adopted in the present work would seem to be required. This requirement does not appear to have been met.

This book is apparently not yet well known in this country; since it provides an elementary introduction to an essential component in chemical engineering education it is to be hoped that it will now become better known and that it will be given a fair trial by those who will be the ultimate judges of its success, namely the students in this branch of science.

R. F. STRICKLAND-CONSTABLE

**Thermodynamics for Chemical Engineers*, by H. C. Weber and H. P. Meissner. 2nd edition. John Wiley & Sons Inc., New York, 1957. Illus. Pp. 508 inc. index. 68s.

Guide to Industrial Chemicals

This book* reflects the changed pattern of chemical production, particularly in the United States, since the first edition appeared in 1950. New chemicals of industrial importance, such as polythene and the diisocyanates, have appeared, while production of such stalwarts as anhydrous ammonia has more than doubled and chemicals such as acrylonitrile have experienced a 700% production increase. The need for radical changes in this work to cover the whole field of industrial chemicals was obvious, therefore, and chapters on 35 industrial chemicals have been added to the original 106.

The scheme of this book is that each chapter deals with a particular chemical, giving details (with alternative routes) of the reaction and process by which it is made and following this with notes on economic aspects, packaging and shipping, finally listing American plants which make the particular chemical under discussion.

The text, as well as the simplified flow diagrams and graphs, is set out with the clarity that is characteristic of American textbooks generally.

**Industrial Chemicals*, by W. L. Faith, D. B. Keyes and R. L. Clark. 2nd Edition. Chapman & Hall, London, 1957. Illus. Pp. 844 inc. index, 128s.

Glass-reinforced Plastics

This new edition* of a work which first appeared in 1954 has been revised and expanded and one new chapter deals with chemical plant applications such as tanks, vessels, pipes and tubing, ducting, etc., and includes tables showing the resistance of laminates to various chemicals and solutions. Other additions to the work include chapters on epoxide resins, and on the injection moulding process, and an appendix briefly describing a method of examining design detail by means of structural models.

Other chapters of the book, each contributed by a different author, deal with numerous aspects of the production, properties and applications of the various glass-reinforced plastics.

**Glass Reinforced Plastics*, edited by Phillip Morgan. 2nd Edition. Iliffe & Sons Ltd., London, 1957. Illus. Pp. 326, 45s.

Chemical Reaction Engineering

Volume 1* of an international series of monographs on chemical engineering contains the papers and discussion, together with the opening and closing speeches, from the symposium held in Amsterdam, under the auspices of the European Federation of Chemical Engineers, on May 7 to 9, 1957. The first session was devoted to general introductory papers on chemical reaction engineering, while the four remaining sessions covered transport phenomena in heterogeneous reactions, non-uniform concentration distributions, reactor efficiency and stability, and reactor development.

The fact that some of the papers are in French or German may detract from the value of this work to the English-speaking reader, but brief trilingual summaries are given. The keen student of this new branch of chemical engineering will not be deterred from adding the volume to his library.

**Chemical Reaction Engineering*. Pergamon Press, London, 1957. Illus. Pp. 200, 80s.

WHAT'S NEWS about

★ Plant
★ Equipment
★ Materials
★ Processes

This illustrated report on recent developments is associated with a reader service that is operated free of charge by our Enquiry Bureau. Each item appearing in these pages has a reference number appended to it; to obtain more information, fill in the top postcard attached, giving the appropriate reference number(s), and post the card (no stamp required in the United Kingdom).

Visual check on flow

The *Telicator* visual flow indicator is designed for high- or low-pressure systems, and is claimed to be successful with extremely high or low rates of flow at any viscosity. Comparative flow can be readily gauged by a glance at the rate at which the rotor is revolving—this rotor being clearly visible through its cartridge case of *Perspex* or glass.

These indicators have a number of applications in different branches of industry, including forced-lubrication systems and water supplies for cooling purposes. A special model is available for use with opaque liquids. Details can be obtained from Sir W. H. Bailey & Co. Ltd., or by making use of the CPE reader service quoting: **CPE 893**

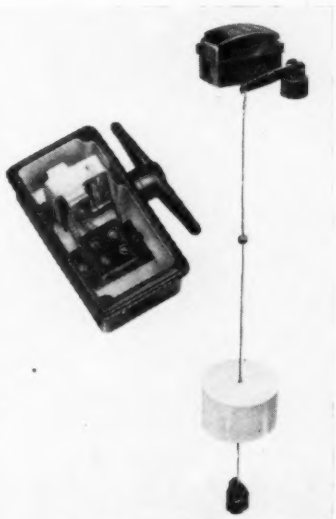
Float switch

The principal application of Girdlestone float switches is the automatic or remote control of electrically driven pumps of all types. They can be used for direct switching in the case of small single-phase motors, but for d.c. supply, three-phase a.c. supply and the larger single-phase installations they must be used in conjunction with automatic contactor starters. They are also used for many other purposes such as liquid level alarms, limit switches, motorised valve controls and, in fact, for almost any condition where electrically driven equipment is required to be actuated by change in liquid level.

The new, type MS-5, float switch has a single-pole mercury tube carried in a phosphor-bronze cradle actuated by a positive-spring-controlled tilting mechanism. Connecting leads are insulated with porcelain beads which provide permanent freedom of movement and are connected to a heavy *Bakelite* terminal block with easily accessible fully shrouded wiring terminals.

Expanded polystyrene floats suitable for liquids up to a temperature of 150°F. are supplied as standard equipment, and thus the buoyancy of the float is not affected by damage caused through abrasion, impact or ice.

Float gear is available in copper for liquids exceeding 150°F. and in stainless steel or polythene for certain acids and corrosive fluids. **CPE 894**



Principle of float switch illustrated.

Dry-type air filter

The new 'M.V.' type of dry air filter produced by the Visco Engineering Co. Ltd. is a development of the same company's 'C.E.' type but occupies about two-thirds of the space and sells at about two-thirds of the price for a filter of given capacity. The overall size of the filter unit is the same as that of the standard, vertical, panel-type, oil-wetted air filter. This means that where two-stage air filtration is required both types of filter can be fitted into the same housing.

Each 'M.V.' filter comprises a frame and a removable cell. The cell consists of two sections which fit together to hold the filter pad firmly between them. The two sections are fixed rigidly together for easy and safe handling. The assembled cell rests on the side cheeks of the frame and is firmly clamped to a felt seating. The 'throw-away' filter pads are made from a new, synthetic, fibrous material, the fibres of which are not dislodged by air movement while the raw edges of the pads are on the dirty side of the cell, thus eliminating the possibility of fluff being picked off into the air stream. **CPE 895**

Plasticiser for resins

A new plasticiser, NTP, is claimed to combine a very high flame resistance with the absence of toxic properties. It can thus be used in formulations in which conventional flameproof plasticisers are unsuitable. NTP is miscible in all proportions with the following solvents: ether, alcohol, acetone, benzene, toluene, amyl acetate, carbon tetrachloride, trichlorethylene and carbon disulphide. **CPE 896**

C.P.E.'S MONTHLY REPORT AND READER SERVICE

Flame failure control

A photocell and electronic circuit that is sensitive to flame only and is not affected by radiation is used in a flame failure control unit now available. Failure of the flame in a gas- or oil-fired heating unit is followed by shutting off of the fuel supply, and then an automatic purging. In the case of the semi-automatic system re-ignition must be performed by some other means. In the fully automatic type relighting of the main burner is effected by this unit. **CPE 897**

Test sieve shaker

The new, streamlined *Endrock* test sieve shaker, totally enclosed and fitted with anti-vibration mountings and with a built-in time switch, offers a means of saving time for skilled technical personnel in separating operations, the operator having only to set the machine, press the time switch and record the result.

The unit will carry seven full-height and 13 half-height test sieves of 6-in. or 8-in. diam., the sieves being carried on a rubber-lined table and held firmly in place by a clamping plate which slides up and down between two vertical rods and which can be secured at any designed height by two large wing nuts. This table does not rotate, but it is inclined to an angle of approximately 15° from the vertical axis of the machine and, while this angle of tilt is constant, the direction towards which the table inclines changes progressively in a clockwise direction.

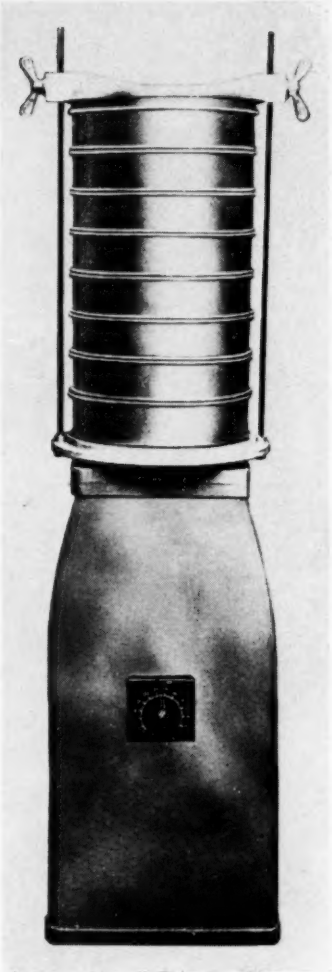
Coupled with the gyratory movement of the table there is an upward and downward movement at a frequency approaching 300 vibrations/min. at an amplitude of approximately $\frac{5}{32}$ in.

This machine is powered normally by a fractional-h.p., a.c., single-phase motor to work off either 200/220 or 230/250 v., 50 cycles, and also has a built-in time switch, which can be pre-set for tests of any duration between 0 and 60 min., the scale being divided into 1-min. intervals. **CPE 898**

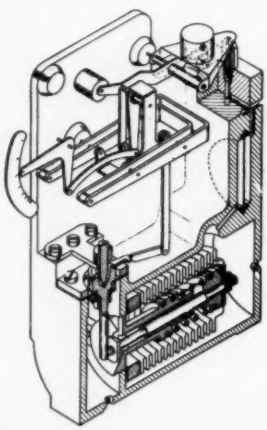
Pneumatic control

A pneumatic control unit is available with a stabilising feedback link between the nozzle and the bellows chamber, in parallel with the normal feedback circuit *via* the relay and derivative valve resistance. This comprises a passageway between nozzle and bellows chamber, intersected by a diaphragm, the stiffness of which is arranged so that approximately 1 to 2% of a pressure change at the nozzle is felt in the bellows chamber. This change occurs with extremely small dead-time so that much greater stability is possible, and there is greater air output to the regulator.

The small feedback effect theoretically reduces the phase advance provided by the derivative resistance contained in the normal feed-back circuit, but in practice the loss is said by the makers, George Kent Ltd., Luton, to be negligible. **CPE 899**



'Endrock' sieve shaker.



Section through Kent pneumatic control (new passageway centre right).

Differential pressure gauge

A high static differential pressure gauge, suitable for use with pressurised storage tanks and flow lines, has been designed to operate with static pressures up to 150 p.s.i.

With ranges from 0 to 50 in. w.g. the instrument can withstand pressures of 150 p.s.i. as an overload on either the high or low side without causing calibration changes on returning to normal conditions. For ranges 0 to 25 in. w.g. overloading conditions of up to 100 p.s.i. can be accommodated. This refinement, which is achieved by a liquid-filled collapsible system, is claimed by the makers, K.D.G. Instruments Ltd., to give full protection against any line breakage or fault. **CPE 900**

Graphic recorder

Where two quantities are related in some way to each other it is often a great convenience to be able to reproduce them side by side on a common chart. As the name implies, the Record Electrical Co.'s *Duplex* graphic recorder consists of two recorder movements mounted side by side in a common case with a common chart mechanism.

At present a flush pattern only is available. The chart width is approximately 8 in. overall, each movement operating on a 3-in. ruling. In addition there is a $\frac{1}{4}$-in.-wide track down each side of the chart so that one or two marker pens may be added if required. The time figures are boldly printed down the centre of the chart. Each chart is 65-ft. long, giving a month's record at 1 in./hr.

The chart mechanism is driven by a synchronous motor and has speed change giving a choice of any two speeds per hour or per minute between $\frac{1}{2}$ in. and 12 in. **CPE 901**

High-vacuum crystallisers

Two high-vacuum crystallisers, to be installed at the Courtaulds Ltd. works at Preston, are of the Kestner continuous high-vacuum type and each is designed to crystallise out many tons of Glauber's salt per 24-hr. day from rayon spinning bath liquor. The liquor will be cooled to as low as 5°C. by flash evaporation. The high vacuum needed will be obtained by means of steam-operated vacuum augmentors followed by barometric condensers and two-stage air ejectors. The materials of construction of the plant will include a high proportion of the corrosion-proof material *Keebush*, with other parts in rubber and lead-lined mild steel.

Makers: Kestner Evaporator & Engineering Co. Ltd. **CPE 903**

WELDING PVC

A high-frequency welding machine is claimed to be capable, with the use of interchangeable plattens and tools, of meeting almost every need that is likely to be called for in the use of PVC. This compact machine, produced by H. F. Industrial Services Ltd., is easily moved around, rubber castors being provided at the 'heavy' end so that it can be pushed like a trolley.

Operation is by foot pedal, a pedal pressure of only 15 lb. being required for a pressure of 250 lb.

Cellulose acetate can also be welded with this machine.

CPE 902

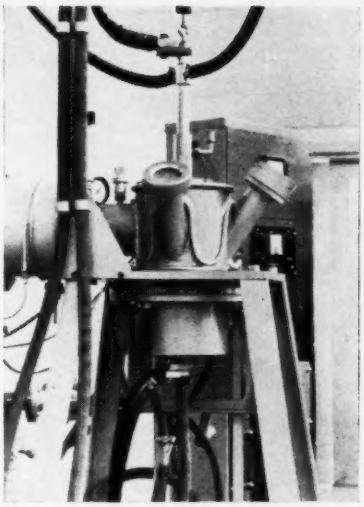
Neon figures replace conventional instrument dial

Instead of a pointer swinging to rest on a scale, 2-in.-high, neon-lit figures shine forth to give the actual reading on the Solarton *Digicator*. It is completely electronic and operates virtually instantaneously. There are no mechanical switches.

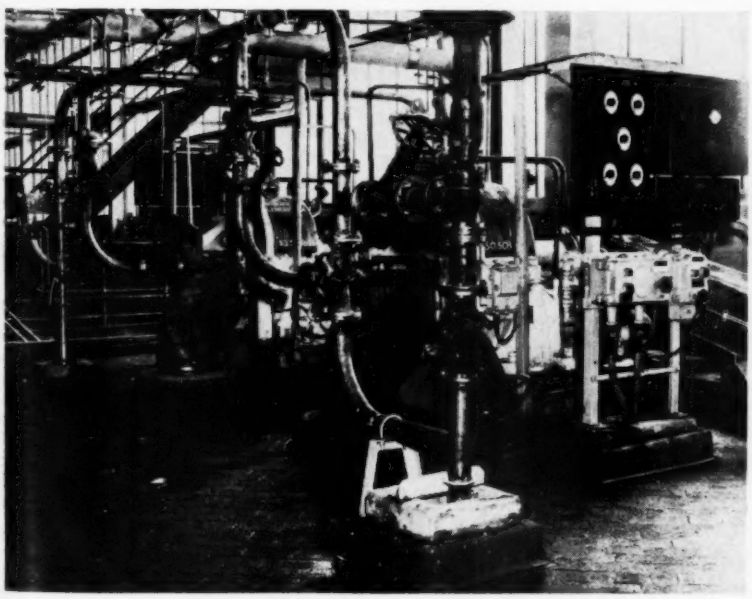
A further advantage pointed out by the makers is that the *Digicator* works on the voltage-change principle, has negligible current needs and thus does not bleed any measuring or transducing circuits to which it may be connected.

Any parameter which can be transduced into a voltage varying according to the parameter variations can be read as *Digicator* numbers. Power, pressure, speed, weight, length, temperature, capacity, voltage, current, polarity, qualitative comparison around a norm and many others are a few examples of the instrument's scope in scientific, technical and industrial application.

In the ordinary model there are two Ericsson cold cathode tubes containing 0 to 9 each in clear-glass tubes. Thus the *Digicator* reads from '00' to '99,' or 01 to 9.9 volts. A patented system of electronic switching circuits controls these tubes and causes the necessary numerals to glow in each tube according to the value of the voltage in the *Digicator's* balanced circuit. **CPE 905**



Vacuum and argon arc furnace as described below. Close-up of the furnace body showing the arrangement for non-electrode operation.



CENTRIFUGES AT WILTON

Eleven C-27 Super-D-Hydrators *have been installed on crystal separation in I.C.I. plant at Wilton, Yorkshire. The photograph shows part of this installation. At other stages* Super-D-Hydrators *are processing slurries at sub-zero temperatures. In all cases these centrifugal units, supplied by Sharples Centrifuges Ltd., are operating continuously under conditions of automatic control by means of time-cycle controllers, enabling the required product specification to be obtained under the varying conditions of plant operation and throughput.* **CPE 904**

Vacuum argon arc furnace

There is a great interest in the metallurgical industry at the moment in all aspects of vacuum melting and the use of vacuum/arc and argon/arc furnaces is of considerable importance. Refractory metals such as molydbenum and tungsten require a high melting temperature and this can be achieved by using a direct arc as the heat source and water-cooled copper hearth as the crucible material. Using this arrangement, specimen buttons of tungsten and molybdenum can be prepared in a low-pressure argon atmosphere. Reactive metals such as titanium and zirconium can conveniently be melted and cast in a vacuum using the consumable electrode technique, where

the material being melted forms the actual electrode. The operation is both quick and effective and a new laboratory-scale arc furnace has been developed in which ingots $1\frac{3}{4}$ in. diam. and $10\frac{1}{2}$ in. long can be cast.

The furnace, produced by Edwards High Vacuum Ltd., is a compact and versatile unit, capable of being used for both consumable and non-consumable electrode work. The dual-purpose version of the furnace is pumped by a 9B3 booster vapour pump backed by a 1SC450 rotary pump displacing 15 cu.ft./min. These booster pumps are specially designed for metallurgical processes where large-scale degassing occurs during heating and melting. An outstanding feature of the pump is its ability to work against backing pressures as high as 3 mm. Hg, thus enabling it to be used in the pumping cycle when the efficiency of the rotary pump is still high. The unbaffled speed of the 9B3 is 900 litres/sec. at working pressures as low as 0.004 mm. Hg and it has a maximum gas throughput of 18,000 litre microns/sec.

If required solely for non-consumable electrode operation, the high-speed booster pumping system is not necessary as the furnace will operate in a low-pressure argon atmosphere. To maintain purity in melting, however, a smaller pumping system is provided consisting of a model 203 oil diffusion pump capable of attaining an ultimate vacuum of 5×10^{-6} and having an unbaffled speed of 80 litres/sec. This is backed by a *Speedivac* 1SC150 rotary pump displacing 5 cu.ft./min. Vacuum measurement in the backing line is provided by a B2 Pirani-type vacuum gauge which can also be used as a leak detection unit using the hydrogen/Pirani method.

The plant is completely self-contained, vacuum gauges and other electrical instruments being built into a separate pedestal cabinet. **CPE 907**

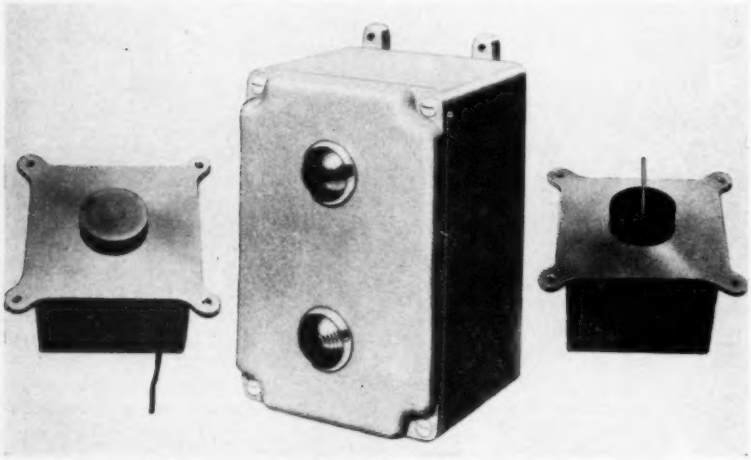
HIGH TEMPERATURE AT ATMOSPHERIC PRESSURE

The bringing into operation of four *Turbofin* fluid heat transmission units at the works of the Elektrokemisk company in Norway draws attention to this means of obtaining temperatures up to 300°C. at atmospheric pressure. The principle employed is to transfer heat by means of a circulating fluid which picks up heat from a fuel and passes it to a process. The system uses a non-toxic mineral oil which is kept in liquid phase. The makers point out that, as the pressures involved are never greater than the pumping losses, the process equipment necessary to operate in conjunction with it can be of the cheapest and simplest form. Compactness is a further advantage of the *Turbofin* units. **CPE 906**

Level indicator

An instrument designed to indicate whether a container is full or empty between given levels is made by Goring Kerr Ltd., Gerrards Cross, Bucks. It consists of an indicating unit and one or two probes, which are inserted, as required, into the tank or container. The electrical capacity between the probe elements and the container is altered by any liquid, powder or granular substance in close proximity to the probe, and this actuates the indicator at the probe levels.

With this instrument any length of cable can be used between the probe and the indicator, enabling the readings to be taken at ground level. It is claimed to be very sensitive and stable over long periods and to require no attention after installation. **CPE 908**



Level controller with two alternative types of probe.

Punched card readers in automatic control

Control installations recently completed by the automation division of Dunford & Elliott (Sheffield) Ltd. necessitated the development of special industrial-type card readers.

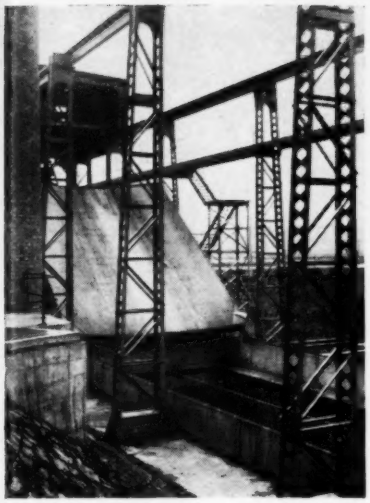
One such installation involves the pre-setting of a given quantity of liquid and the selection of a given outlet by means of a punched card. The unit is required to read the last two rows of 12 holes of a standard accounting machine card, the remainder of the card being available for normal accounting purposes. The construction of the unit is such that a card cannot be inserted wrongly, and cannot be withdrawn unless a release signal is given.

Another installation employs a desk-mounted card reader to remotely set and programme automatic weighing machines each being fed by four bunkers. The desk-mounting units are particularly suitable for industrial applications calling for heavy-duty cards and much larger storage capacity, *i.e.* 24 rows of 12 holes. The cards are sufficiently robust to allow binary coded punching to be employed so that considerable information storage capacity is available.

Development is at present being carried out on a card reader having a capacity of 100 rows of 12 holes. A special feature of this unit is that, when the information on the card has been dealt with, an automatic release signal is given and the card is dropped into a locked box which is an integral part of the unit. The card is thus automatically stored for future use or reference. **CPE 909**

High-resolution spectrometer

A nuclear magnetic resonance spectrometer will be introduced in Britain which has been designed for chemical analysts and the research workers who require a resolution sufficiently high to show chemical



SCALE CHUTE

This scale chute at the Brinsworth continuous medium-width strip mill of Steel, Peech & Tozer, Rotherham, covers an area of 3,000 *sq. ft. and was coated with United Coke & Chemicals'* Ulak *No.* 4 *primer and epoxide paint. Originally, the chute was coated with red lead paint, most of which had disappeared, leaving part bare metal and part corroded metal surfaces. Loyne Ltd., of Ashton-under-Lyne, who did the painting, would not normally attempt to coat such a surface with epoxide paint without prior shot-blasting treatment, but the use of* Ulak *No.* 4 *made it a practical proposition and also reduced the cost. Six months later, the coating was still in excellent condition and no 'lifting' of either the primer or epoxide had occurred.* **CPE 910**

shift, at a cost comparable with that of other types of moderately priced laboratory spectrometers.

N.M.R. spectrometry is fundamentally a non-destructive means of studying molecular structure by measuring the magnetic properties of the atomic nuclei composing the molecule. It is limited to those elements with magnetic moments greater than zero but in practice there is a suitable isotope for most elements. The protons in different positions in a molecule are subject to varying degrees of magnetic shielding, and hence a high-resolution N.M.R. spectrometer records a corresponding series of resonances whose relative dispositions are frequently termed chemical shifts, and whose relative magnitudes are proportional to the numbers of protons in each position. Elucidation of the finer details of complex structures is usually possible by correlation with N.M.R. spectra of similar groupings in simpler molecules of known structure.

N.M.R. has also been applied successfully to the determination of moisture in agricultural products and food ingredients and has been proved suitable for industrial process control in this and other applications.

The new equipment will be introduced by Fairey Aviation Co. **CPE 911**

Cutting plastic tubes

The designers and manufacturers of a range of guillotines and shears, Wallis Engineering Co., have brought out a device which facilitates the cutting of tubes or rods of polythene and similar materials.

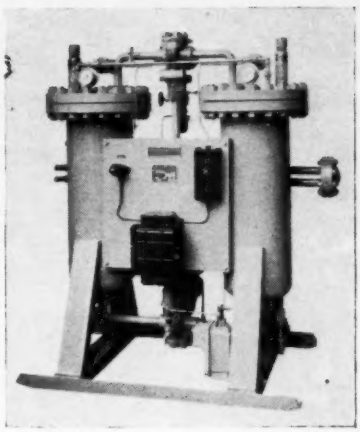
Cut pieces of up to $\frac{1}{2}$ in. outside diameter produced by this attachment are square cut to dimensions within ± 0.010 in., and the output is 240 pieces/min. based on 8-in.-long pieces.

The guillotine can be hand-operated or motor-driven by V-belt and an electrically operated counter may be fitted which automatically stops the machine when the desired quantity of pieces has been reached or production requirements dictate a change in measurements. **CPE 912**

Air-operated stirrer

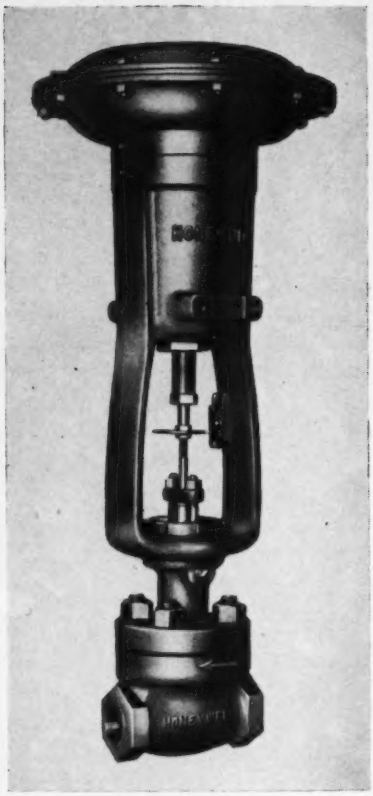
An air-operated unit has been added to the range of portable-type stirrers made by the Kestner Evaporator & Engineering Co. Ltd. It is completely flameproof, the prime mover being a rotary-vane air motor suitable for working pressures of up to 90 p.s.i. with integral sun and planet reduction gear driving a stainless-steel, or plastic-coated, shaft which is fitted with two opposed propellers. Small size and light weight are among the advantages of this motor over the conventional, totally enclosed electric motor. **CPE 913**

Air-operated stirrer mounted on the side of a vessel.



DEHYDRATION

The picture shows a typical dual-adsorber Humidryer *for drying high-pressure nitrogen used in a chemical process.* Humidryers, *described in our March issue, remove moisture from air, gases and certain liquids by means of activated alumina. These dual-adsorber units cover a wide range of applications.* **CPE 849**



Diaphragm control valve.

Tricky work in 'Perspex'

Some delicate operations were involved in the construction of a conductimetric cell perfected by the General Electric Co. Ltd. and used in their research laboratories. The operation of this cell, used for the determination of carbon in metals, consists of heating the sample in oxygen until the carbon in the sample is converted into carbon dioxide. The carbon dioxide is then dissolved in a solution of caustic soda or barium hydroxide and the change in conductivity of the solution is measured. It was decided to use *Perspex* because of its insulating qualities and chemical resistance; it was transparent and could be machined.

To produce the body, a piece of *Perspex* tube of the required height and diameter was used. This was bored concentric with the i.d. to a depth of approximately ½ in., both ends then being faced off to receive the end plates which had to make a perfectly flush fit.

The helical gear, used as a path for the gas bubbles, was made from a solid block of *Perspex* which, after being turned, bored, drilled and tapped was ready to receive the last but most important operation: the cutting of the helical thread in one clean cut. Owing to the width and depth of cut and the fragile wall of the helix, this was a very delicate operation and a special device had to be made which proved completely successful, giving a very highly machined finish which greatly helped the final polishing of the thread.

Some further delicate work involved the use of a specially made drilling device with magnifying glass attached.

The whole of the work was carried out for G.E.C. by R. O. Harris & Co. Ltd., who specialise in the fabrication and machining of *Perspex* for industry.

CPE 914

Diaphragm valves for process control

Honeywell-Brown Ltd. are now making a comprehensive range of diaphragm control valves, complementing their established range of miniature and conventional pneumatic controllers. Single-seated, double-seated, low-flow and three-way types are all available in a variety of body and trim materials.

Single-seated valves give throttling action with tight shut-off. A choice of plug types provides equal percentage, linear or quick-opening action. Sizes range from 1 to 8 in.

Double-seated valves, for pressure-balanced throttling action on processes where fluid pressure is high, offer the same range of plug types, with the addition that equal percentage plugs can be either V-ported or contoured. Sizes from 1 to 8 in.

Low-flow valves. Available in body sizes from ½ to 1 in. Reduced port sizes ranging from ⅛ to ¾ in. give flow coefficients suitable for low-flow control, both in the laboratory and on the process. Plug action is equal percentage.

Three-way valves, single- and double-seated, can be piped for mixing or diverting service. Design ensures that flow always tends to open the plug, gives increased stability and eliminates slamming. Body sizes range from ½ to 8 in. **CPE 915**

ELECTRONIC PHOTOCELL HELPS FERTILISER LOADING

At the Barking factory of Fisons Ltd. a simple form of electronic photocell counting is employed in conjunction with their multi-wall paper sack filling machine, to give the aggregate count of sacks per shift, the load per lorry and the number of burst sacks. Two men only are needed to control this system—one to operate the two head filling machine and one to keep him supplied with sacks, take off 'bursts' and switch the chute guide as each lorry load is completed, there being two lorry 'stations' at the loading bank.

Display counters are remotely fitted and the first display counter registers the lorry load total and the completion of this total is the signal for the second operator to switch the chute guide so that the second waiting lorry can commence loading, the second display counter registering the aggregate for the shift.

Inevitably there are a certain number of burst sacks and the total number of 'bursts' at any time can be quickly ascertained by use of this equipment.

The electronic counting equipment was supplied by Electronic Machine Co. Ltd.

CPE 916

INDUSTRY REPORTS

Monsanto schemes bear fruit

New high records in productive efficiency were reported in the statement of Sir Miles Thomas, chairman of Monsanto Chemicals Ltd. (United Kingdom). During 1957 the company spent £2,983,486 on capital projects.

Demand for phthalic anhydride and maleic anhydride exceeded available plant capacity. The new maleic plant was commissioned and output was accelerated towards the year's end. Construction of the new phthalic plant was also completed. The phenol plant at Ruabon has been substantially extended and designs were completed during the year for a further large increase in productive capacity. Engineering on this plant is well advanced and will be completed in 1958.

Production of cyclohexylamine and dicyclohexylamine began at Newport early in the year, whereby the company established a basic raw material position in support of its rubber chemical manufacturing programme.

In the plastics division, many new plants and extensions of existing plants were brought into commission at Newport and Ruabon. At Fawley excellent progress was made in the construction of the new plant for the production of polythene.

Chemical engineering research has been strengthened by forming a central group available to assist both divisions and to work on process and equipment development of broad company interest.

Fertilisers in Israel

The annual report of the directors of Fertilisers & Chemicals Ltd. (Israel) mentions that, on the production side, the ammonia and ammonium sulphate and, later on, dicalcium phosphate plants came into commercial production and fulfilled the main objective of the company: to produce the full range of all three kinds of fertilisers and to supply all needs of the country. The year would have been a record year of production, had there not been a setback due to the Sinai campaign when supplies were stopped and communications interrupted.

During the first half of the year steady production was maintained in all plants and monthly output figures exceeded those of the previous year. The output of nitrogenous fertilisers alone in the first half of the fiscal year surpassed output during the corresponding period of the preceding year by 63%.

Du Pont plant expansion

In 1957 the Du Pont Co. (U.S.A.) spent $220 million in the construction and expansion of plants, laboratories and service units, it was disclosed by Mr. C. H. Greenewalt, president. This figure is an increase from $157 million in 1956.

Six new plants are under construction. Among the products involved in the expansion at these and other locations are nylon, *Orlon* acrylic staple, cellophane, titanium pigments, *Alathon* polythene resin, *Dacron* polyester fibre, sodium, silicon, *Mylar* polyester film, *Teflon* tetrafluoroethylene resin, sulphuric acid, neoprene synthetic rubber, tetraethyl lead antiknock compound, sodium carboxymethyl cellulose, sulphamic acid, and *Hypalon* synthetic rubber.

Mr. Greenewalt reported that the company spent $80 million on research and development during the year, exclusive of laboratory construction and technical assistance to manufacturing and sales.

Plastics prospects in the U.K.

Given reasonable trade conditions, there is no limiting target yet in sight for the expansion of the United Kingdom plastics industry, said Mr. H. V. Potter, president, at the annual meeting of the British Plastics Federation in London.

Output last year was estimated at 400,000 tons, worth about £110 million, and an increase of nearly 20% on the figures for 1956—there had been substantial rises each year, except for 1952. To complete 'no mean record,' exports of raw materials in 1957, 112,000 tons worth nearly £30 million, represented an increase in value of nearly 15% over 1956.

Nickel project's progress

Favourable progress in the development and construction work for the company's new nickel project in Manitoba, where it is opening underground mining operations and is building a mill, a smelter and a refinery, was reported by the chairman and the president of the International Nickel Co. of Canada Ltd.

Total ore mined from the company's Subdury District mines was the largest yet achieved. International Nickel's capital expenditures of $43,921,000 in 1957 were the highest for any year in the company's history.

Rubber-to-metal bonding agent

Installation of a full-scale plant to produce various grades of *Ty-Ply*, a rubber-to-metal bonding agent previously imported from the U.S.A., is reported by the chairman and managing director of Anchor Chemical Co. Ltd. (U.K.). Recalling that at the beginning of 1955 the company's latex and dispersions department was reorganised and extended, he reported that since then a further decision has been taken to enlarge production capacity and plans are now in hand.

Comical Engineering Corner

"VERY INTERESTING, WILSON, BUT TURNING BASE METALS INTO GOLD IS NOT WHAT WE PAY YOU FOR"

Pumps at Shell Haven

DEAR SIR,

We wish to refer to an article which appeared in your September 1957 issue entitled 'Pumping Petroleum Products.' We are sorry to inform you that there was an error in the information which we supplied to you, and thus, referring to pumps of our manufacture, type HO-HL6Y, installed in the thermal reforming unit at Shell Haven, the article states that 'sealing arrangements are thorough with soft-type packing in the stuffing boxes . . . .' It has, however, been drawn to our attention that, while soft-type packing was originally used for these pumps, this was subsequently replaced by *Flexibox* mechanical seals. The debutaniser reflux pump to which reference is also made in the paper is also fitted with *Flexibox* seals.

Yours faithfully,
M. SIGMUND,
Managing Director
Sigmund Pumps Ltd.,
Team Valley,
Gateshead 11.

The AMERICAN Scene

A summary of recent happenings in the United States

A new synthetic rubber which, among other advantages, can triple the life of key equipment used in manufacturing tyres, has been invented and developed by Esso Research & Engineering Co., according to an announcement from Linden, N.J. It is stated that the new polymer withstands high temperatures, can be cured rapidly, is compatible with both natural rubber and other synthetic rubbers, resists distortion and is less vulnerable than other rubbers to harmful chemical elements in the air such as ozone.

In demonstrations of the product's heat resistance, an average of 625 tyres was produced with curing press bladders made of the new synthetic, at a temperature of 385°. Under such conditions, only about 200 tyres can be cured with conventional bladders before they wear out.

Plans are under way for commercial-volume production of the new synthetic known as 'MD 551.' The feasibility of large-scale production was proved in a Baton Rouge, La., pilot plant with a capacity of 1 ton/day. An expansion of the pilot unit to 3 tons is under consideration.

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Meanwhile at Akron, Ohio, the Goodyear Tire & Rubber Co. has started producing *Natsyn*, a new type of synthetic rubber which has the molecular structure and performance characteristics of natural, tree-grown rubber. Quantity production has been made possible with the completion of a big new plant, built at a cost of some three-quarters of a million dollars. Goodyear expects soon to undertake the engineering of a full-scale plant of 25,000 to 30,000 tons p.a. capacity.

Full-scale production of *Natsyn* depends on the availability of isoprene and at present the supply of isoprene is inadequate, with only one commercial producer in the United States. Potential producers, however, appear to have the development processes for making a low-cost, high-purity product well under way.

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A new, 500-ton/day sulphuric acid plant has been added to their Beaumont, Texas, facility by Olin Mathieson Chemical Corporation. Previously there were two 100-ton plants operating on sulphur. Additional construction is under way, including a new unit for the manufacture of ammonium sulphate.

The new plant is a sulphuric acid regeneration plant operating on raw materials from nearby oil refineries. It includes a scrubber based on the *Cominco* process.

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A new process for recovering gallium has been developed by the Dow Chemical Co. The method consists of treating sub-divided ore containing the metallic element with a current of hydrogen chloride or hydrogen bromide under substantially anhydrous conditions at temperatures ranging from 700 to 950°C. The current is utilised in an amount sufficient to volatilise gallium as the trihalide and condensing and recovering it as the pure material.

The new process, according to Dow, will make possible the extraction of substantial qualities of gallium from ores.

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Some 6,200 ft. of polythene pipe are now in continuous, round-the-clock use at the Ashtabula, Ohio, chemical complex. Fabricated in 30-ft. sections weighing 120 lb. each, the pipe is more than an inch in thickness with an inside diameter of 6.07 in.

Linking the zirconium and titanium sponge plant of Mallory-Sharon Metals Corporation and the sodium plant of U.S. Industrial Chemicals Co., the pipeline, fabricated of *Petrothene* high-pressure polyethylene resin with carbon black added, is used to transport a saturated brine solution (at temperatures ranging between 80 and 90°F. and a pressure of 75 p.s.i.g.) from the sponge plant to the sodium chloride reservoirs in the electrolysis plant. The corrosive brine, a by-product in the manufacture of titanium and zirconium sponge, is broken down into its sodium and chloride components by electrolysis and reintroduced into the system.

Coupled with welded and bolted flanges, the 30-ft. sections weighing 120 lb. each were joined at the installation site. Actual installation was simple since, unlike steel pipe which requires careful handling and detailed adjustments in the trench, assembled sections as long as 300 ft. were simply rolled into place with a single push.

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The American Institute of Chemical Engineers will celebrate its 50th anniversary in Philadelphia from June 22 to 27. A highlight of the meeting will be a technical programme summarising 50 years of progress in chemical engineering and taking a look at the future.

The symposia aimed at revealing the influences on chemical engineering technology of intense activity in such new fields as nuclear energy, missiles, and systems engineering should prove especially interesting.

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Evidence of the progress that has been made in the design and construction of engineering design models is provided by a model of a catalytic reforming unit constructed of prefabricated components. The technique was developed by the M. W. Kellogg Co., New York, and the model duplicates in miniature a plant now

producing high-octane gasoline components in an Illinois refinery. It shows all the detailed engineering and the equipment actually used to reform petroleum components. It was originally constructed as an engineering design tool and later used as a construction and operator training aid at the site where the catalytic reforming unit was built.

The piping, valves, heat exchangers, pumps, compressors, ladders, steps, platforms and other components of Kellogg models are preformed plastic in $\frac{3}{8}$ in. to 1 ft. scale, designed so they can be assembled quickly and accurately without glue. Only equipment such as towers and furnaces need to be specially fabricated to represent designs. Through the use of these prefabricated parts, Kellogg has been able to evolve a technique whereby the planning and layout design of processes and plants can be accomplished entirely with models, virtually eliminating the usual engineering drawings.

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A further expansion of hydrofluoric acid facilities at Calvert City, Ky., costing several million dollars, has been put under way by Pennsalt Chemical Corporation and will be completed in July of this year.

As a part of its integrated Calvert City operations the company owns extensive deposits of fluorspar in western Kentucky, this mineral being the basic raw material for the production of hydrofluoric acid. At present a mine and mill are in operation producing fluorspar near Calvert City. In the Republic of Mexico, Pennsalt also owns and operates one of the largest fluorspar mines in the western hemisphere.

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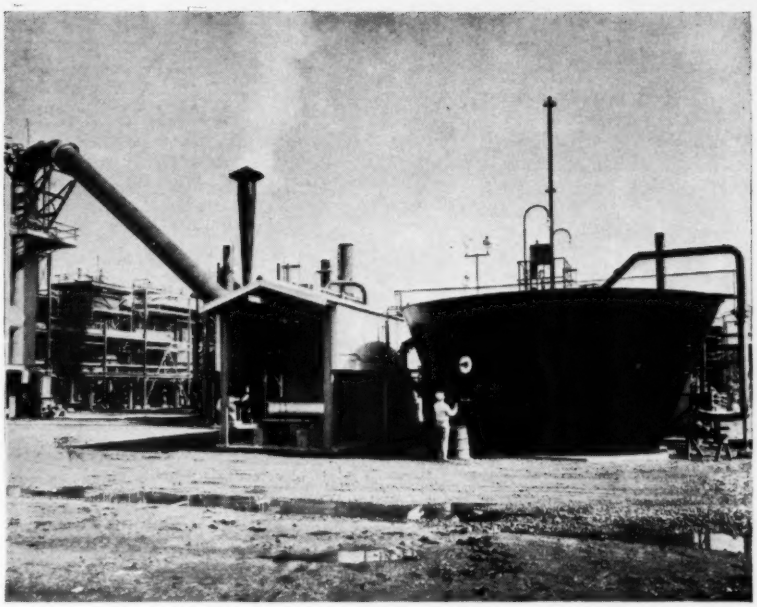
Production of nuclear reactor feed materials has started at a new, $2-million plant of the Davison Chemical Co. Division of W. R. Grace & Co. at Erwin, Tenn. The plant takes thorium or uranium concentrates from industrial sources, or enriched uranium hexafluoride from Atomic Energy Commission gaseous diffusion plants, and converts these source materials to thorium oxides, nitrate, metal or alloys; uranium oxides, tetrafluoride, metal, alloys and other components.

The manufacturing processes follow two main courses, dependent upon whether uranium or thorium is the element concerned. Uranium hexafluoride can be converted to uranium tetrafluoride by reaction under heat with hydrogen. This can be reacted with steam to produce uranium dioxide, or it can be reacted with calcium or magnesium to form uranium metal. The metal is melted in vacuum to produce ingots; these can be either pure or alloyed. Optionally, the metal can be rolled or extruded into whatever form is desired.

The uranium hexafluoride gas can also be dissolved in water or reacted with steam, producing uranyl fluoride in solution or powder form. Alternatively, the gas can be reacted with ammonia to yield ammonium diuranate, which can be decomposed with heat to produce uranium oxide which in turn can be heated in hydrogen and converted to uranium dioxide.

Thorium concentrate is digested in acid and thorium is solvent extracted in pulse columns. Thorium is precipitated with ammonium hydroxide or oxalic acid. Under heat this is decomposed to thorium oxide, which is shipped as such or reacted with calcium to provide thorium metal, which can be compacted or vacuum melted to make ingots and alloys. Or the thorium oxide can be sintered into dense compacts after blending with uranium oxide, and the compacts can be loaded into tubes as reactor fuel elements.



CLARIFIER

Shaped like a giant cauldron, this clarifier is part of a system which takes impurities out of the water before it enters the boilers at the newly constructed sulphuric acid plant of the Olin Mathieson Chemical Corporation at Beaumont, Texas. The additional facilities will increase capacity by 250%. The sulphuric acid is used primarily in the oil-refining industry and the balance is used in manufacture of fertiliser for the Plant Food division of the corporation.

Safety labels scheme

The Association of British Chemical Manufacturers has published a new edition of its publication, 'Marking Containers,' which has been completely revised and brought up to date. The list of chemicals for which warning labels are recommended has been considerably extended and now contains 331 different products. Some alterations to the text have also been made.

The Marking Containers Scheme is intended as a safeguard to all concerned in Britain with the handling, transport and storage of hazardous chemicals up to, and including, the time a container is opened for use on the premises of the consumer. The labels recommended in it contain a signal word, a statement of the main hazards and precautions to be taken, and advice on action in case of accident, using a standardised format and phraseology. The Council of the Association has recommended the manual as a code of practice.

Copies of the new edition can be obtained from the Association of British Chemical Manufacturers, 86 Strand, London, W.C.2, price 10s.

Company News

Dewrance & Co. Ltd., manufacturers of boiler mountings, etc., announce that their subsidiary company, Jones, Tate & Co. Ltd., is now to operate as a division of the parent company, to be known as the Jones Tate division. Mr. C. E. Jones has retired and Mr. P. F. Gifford has been appointed divisional manager. Mr. A. C. Jones is appointed sales manager and operates from the London office. This division manufactures a range of powered, automatic and solenoid-operated valves.

*

Sharples Centrifuges Ltd. recently entertained a party of students, headed by Dr. Stein, from the West Ham College of Technology. The day's programme included a talk on the application of centrifugal equipment and a tour of the works, while the afternoon was spent in the process laboratories, where investigations and experiments were carried out on various aspects of centrifugal technology.

*

The Distillers Co. Ltd. announce that the activities of its Carbon Dioxide, Industrial Alcohol and British Industrial Solvents Divisions in the field of industrial chemicals are being merged into a single chemical division with its headquarters at Devonshire House, Mayfair Place, Piccadilly, London, W.1. The effect of this will be to centralise management, production, control, purchasing and accounting, but sales will continue to be handled by separate departments as heretofore.

*

Organic phosphates are shortly to be manufactured on a commercial scale in Canada for the first time, according to an announcement by Dr. D. E. Jones, president of Electric Reduction Co. of Canada Ltd., one of the Albright & Wilson group of companies. Production is just starting at Erco's Buckingham (Quebec) plant, which was considerably expanded recently.

The present $500,000 annual Canadian market for organic phosphates has, until now, been supplied by exports from the United States and Europe.

*

An arrangement has been made whereby Whiffen & Sons Ltd. and the *Alfloc* water treatment service of Imperial Chemical Industries Ltd. will co-operate in the development in the U.K. of the use of *Zerox* (35% hydrazine solution) for the deoxygenation of boiler feed water.

*

The De Laval organisation recently held a group meeting in London which was attended by senior executives from Belgium, Britain, Canada, France, Germany, Italy, Sweden and the United States.

The increasing demand for centrifuges was discussed (De Laval have some 150 models in current production) and information was released on several new models including a new very large gas-tight separator which has an important application in a separation stage in polythene production; a new, smaller, self-opening separator for fuel and lubricating oils and animal fat purification; machines for use in the various processes of treating uranium ores, etc.

*

The Chemical Construction Corporation of New York have recently made arrangements for Pease-Anthony cyclonic and the newer venturi gas scrubbers to be supplied by their associated company, Chemical Construction (Great Britain) Ltd.

Extensions have been made to the works of Plowright Bros. Ltd. at Chatsworth Road, Chesterfield, and further expansion is envisaged in the future. The company now announces that it is also planning to erect new offices.

Plowright have for some time been manufacturing pressure vessels and tanks for liquids and sludge, rotary drum mixers and structural steelwork in connection with the chemical and gas industries, and we learn from the company that it intends to broaden its scope in these and other fields.

*

Woodall-Duckham Construction Co. Ltd. announce that, to meet the changing needs of the gas, oil and chemical industries, a high-pressure processes division has been established with Mr. H. S. Cheetham as director in charge.

The new division will concentrate upon the provision of complete plants for the production of gases suitable for town supply and chemical synthesis, etc., using modern high-pressure techniques.

*

The high-density polythene marketed by British Resin Products Ltd. on behalf of British Hydrocarbon Chemicals Ltd. will in future be sold under the trade mark *Rigidex*. This plastic is made by a process developed by the Phillips Petroleum Co. who have licensed the manufacturing rights to British Hydrocarbon Chemicals.

Students from West Ham College visit Sharples' process laboratories.

World News

ISRAEL

Calcium carbide

A calcium carbide plant costing I£1.2 million is being built at Petah-Tikva, near Tel-Aviv, by Mayer Chemical Industries Ltd. The electrochemical method will be used and one of the main raw materials, burnt limestone, is available locally, while coal will be imported. Production is expected to reach about 10,000 tons p.a., of which some 3,000 tons will be absorbed by the local market.

Sulphuric acid plant

A new installation for the production of sulphuric acid at the Timna copper plant in the Negev, north of the town of Eilat, was put into operation recently with rather satisfactory results. The copper works at Timna have some reserves of sulphur for the manufacture of the acid, but the Israel Mining Corporation is at present negotiating with several countries for the purchase of sulphur to secure steady production at the plant.

Experts from the United States and Germany will supervise the running-in of the whole plant now. The same experts were previously engaged in the general planning of the Timna copper works and the construction of the equipment which has partly been supplied through German reparation funds.

NEW ZEALAND

Lignin discovery

Regarded as an important step in research on lignin fractions, a discovery has recently been made by the chemists of the Department of Scientific and Industrial Research at the Dominion Laboratory, New Zealand, that the lignin content of *Pinus radiata*, New Zealand-grown exotic pine, is actually 34% and not 28% as has been believed hitherto.

The discovery is the outcome of intensified research by this department in wood chemistry, one of the projects in hand being the improvement of the chemical pulp yield in the wood pulp industry. If the pulp-forming fraction could be increased by 5% the New Zealand wood-pulping industry, on its present output, could produce an extra 10 tons/day of pulp from the same amount of pine logs. At present, there is an unavoidable loss of 23% of the potential paper pulp in the process of dissolving the lignin and efforts are being made to reduce this. Mr. I. R. C. McDonald is in charge of the Wood Chemistry Section of the D.S.I.R. in New Zealand.

UNITED STATES

Copper refinery contract

The M. W. Kellogg Co. has announced that it has been awarded a contract for design, procurement and construction of the Kennecott Refining Corporation's new electrolytic copper refinery near Baltimore, Md. The new refinery will have a capacity of 16,500 tons/month, treating impure metal at 99.4% copper and increasing its purity to 99.95%. Engineering design for the new plant is under way.

The refinery will be totally integrated and will have large-capacity electric-arc furnaces for melting. The plant will include a continuous copper billet casting operation and equipment for casting wire bars, ingots and slabs.

INDIA

Heavy machinery production

A complete unit taking care of all machinery, equipment and components of steel plants and heavy machinery required by the chemical, engineering and other industries is included in India's present plans. The Union Minister of Industry revealed recently that a central heavy machinery building plant was to be established at Ranchi (Bihar) with Soviet collaboration. When in full production it would help to turn out one complete steel plant every two years. A foundry-forge plant would also be established at Ranchi in collaboration with Czechoslovakia.

PORTUGUESE EAST AFRICA

Pulp project

A pulp and paper factory, to be situated between Lamego and Vila Machado, will make use of sawdust and dried grass to produce pulp and is designed to have an output of 9,000 tons of paper p.a. This would cover the total consumption of the province and leave a substantial amount for export.

FRENCH EQUATORIAL AFRICA

Metallurgical and chemical possibilities

The latest estimates for the Kouilou Dam project are that the installed capacity would be 800 megawatts, and that the annual production of the main associated industries would be 200,000 to 250,000 tons of aluminium, 200,000 tons of ferromanganese, 32,000 tons of ferro-silicum, 20,000 tons of silicon carbide, 10,000 tons of magnesium and 33,000 tons of phosphates.

SOUTH AFRICA

Fatty acids

A new plant for the manufacture of fatty acids by high-vacuum distillation was recently brought into operation by South African Oil Mills (Pty.) Ltd. in the Transvaal. The plant is run in conjunction with modern solvent extraction, hydrogenation and fat-splitting units and produces distilled fatty acids from oils including sunflower, maize, soya bean, linseed and coconut oil.

Later it is also planned to manufacture a range of hydrogenated oil fatty acids. It is expected that imports of fatty acids will be materially reduced once the new plant is in full production.

Mining developments

Important new mining enterprises are expected to reach production about the middle of the current year. The mining of the heavy minerals, rutile, ilmenite and zircon, will by then be under way in the region of the Natal south coast between Durban and Port Shepstone. Rutile, zircon and ilmenite will be produced at approximately 7,000 tons, 10,000 tons and 100,000 tons p.a. respectively. The largest portion of these minerals is intended for the export market.

GREAT BRITAIN

Rubber-like foam

A new type of synthetic foam, claimed to be the most rubber-like so far developed, has been produced by Dunlop scientists as a result of research and development work in the United Kingdom and United States. Mainly derived from polyethers and di-isocyanates, the new product is stated to have superior qualities to those of the company's existing synthetic foam, *Dunloprene*, to which it will be complementary. This is attributed to the more chemically stable polyether component and the closer control that can be exercised over the prepolymer manufacture.

Zero-energy reactor

A new zero-energy reactor is now operating at the Atomic Energy Research Establishment at Harwell. Called ' Hazel ' (homogeneous assembly—zero energy), it uses enriched

uranium fuel in the form of a salt of uranium curanyl fluoride which is dissolved in the heavy water used as a moderator.

The core of the reactor is a stainless-steel cylinder (7 ft. high × 2 ft. diam.) surrounded by a graphite reflector. The fuel solution is pumped into the cylinder from two nearby storage vessels. The system is controlled by adjusting the level of the fuel solution in the reactor vessel and by moving a vertical neutron-absorbing cadmium plate into the gap between the steel cylinder and the graphite reflector. Two cadmium plates similar to the control device are used as 'shut-off' rods; two additional 'shut-off' rods can be dropped vertically into the fuel solution in the reactor vessel. The reactor will be operated at a power of less than a watt and cooling is not necessary.

'Hazel' will be used to obtain basic nuclear information. An earlier system at Harwell, ZETR (zero energy thermal reactor) was used to study solutions of nuclear fuel in ordinary water.

Methanol expansion

The Billingham division of I.C.I. is to increase substantially the capacity of the methanol plant at its Heysham works, subject to planning permission being obtained. Demand for methanol is growing steadily and it is also widely used within I.C.I. itself—for example for production of *Perspex*, alkalamines and *Terylene*.

The plant to be installed will be similar to that already at Heysham, but in a more modern form with automatic control equipment. Construction will take about two years.

Mr. S. L. Waide.

Personal Paragraphs

★ **Mr. E. M. Fraser,** C.B.E., sales controller of Imperial Chemical Industries Ltd., has retired after over 38 years' service with the company and its predecessors. **Mr. J. H. Townsend,** at present deputy sales controller of I.C.I., succeeds him as sales controller. Mr. Fraser joined Brunner, Mond & Co. Ltd. in 1919 and was a director of all overseas companies from 1920 to 1924. He was then a director of the British Dyestuffs Corporation (the forerunner of I.C.I.'s Dyestuffs Division) until 1927, when he became a director of Synthetic Ammonia & Nitrates Ltd. (later to become the Billingham Division of I.C.I.). In 1934 he became manager of the south-east sales division of I.C.I., and was appointed sales controller in 1945. Mr. Townsend joined the Billingham Division in 1935. He became joint deputy regional manager, southern region sales office, in 1950. In 1952 he was appointed head of the I.C.I. office administration department, and became deputy sales controller in 1953.

★ **Dr. F. F. Musgrave** has been appointed personal assistant to **Mr. S. Barratt,** chairman of the Albright & Wilson group of companies. Dr. Musgrave was formerly managing director of Lubrizol Great Britain Ltd. He is a Canadian and, after early experience with Imperial Oil Ltd., a Canadian subsidiary of Standard Oil, he joined the Lubrizol Corporation of Cleveland, Ohio, as chemical research director, later becoming technical assistant to the president. Dr. Musgrave was closely concerned in the establishment in the U.K. of Lubrizol Great Britain Ltd., formerly known as Anglamol Ltd. He was appointed managing director of that company in 1949.

★ **Dr. M. A. T. Rogers** has been appointed research controller of Imperial Chemical Industries Ltd. He succeeds **Mr. R. M. Winter** who is retiring from the company after 30 years' service. Dr. Rogers joined the Dyestuffs Division of I.C.I. as a chemist in 1934. During the war he became engaged on penicillin research and he joined the medicinal research division of the Dyestuffs Division. In 1949 he became head of the academic relations department of the Dyestuffs Division. Mr. Winter joined Synthetic Ammonia & Nitrates Ltd. (now the Billingham Division of I.C.I.) early in 1928 and was transferred to the I.C.I. General Chemicals Division as research manager in 1931. In 1937 he moved to head office as chief assistant to Dr. Slade, who was then research general manager, and was appointed research controller in 1946.

★ **Mr. P. A. Ashby** has been appointed engineer in charge of design and sales of chemical plant by Freeman Taylor Machines Ltd. This appointment coincides with the firm having secured the sole manufacturing licence and agency for the U.K., Eire and Commonwealth for Olsa of Milan, designers and manufacturers of chemical and pharmaceutical plant, stainless-steel valves and ancillary plant.

★ **Mr. S. L. Waide** has been appointed a member of the board of Newton Chambers & Co. Ltd. He joined the company as a local director and general manager of the chemicals division in July 1955 and, since September 1956, has been assistant managing director in complete charge of that division, which is concerned with the manufacture and marketing of the well-known *Izal* products. Before joining Newton Chambers he was works director with T. J. Smith & Nephew Ltd., makers of *Elastoplast*.

★ **Mr. R. P. Wright** joins Newton Chambers & Co. Ltd. as *Izal* factory manager. He will fill the vacancy caused by the death of Mr. J. Connell. Latterly, Mr. Wright has been production superintendent in the textile processing departments of British Enka.

★ **Mr. B. H. Turpin,** managing director of Q.V.F. Ltd., has been appointed managing director of Quickfit & Quartz Ltd. Both companies are members of the Triplex group of companies. Mr. Turpin joined Quickfit & Quartz in 1937 as technical manager. Later he was appointed to the board from which he resigned in 1953, on the formation of Q.V.F. and his subsequent appointment as that new company's managing director. In his new post, Mr. Turpin succeeds **Sir Graham Cunningham,** who continues as chairman.

★ A New Zealander, **Mr. O. N. Williams,** has been appointed managing director of Cyanamid of Great Britain. For the past six years he has been a Cyanamid director, and also general manager of the company's Lederle Laboratories Division in Britain. He succeeds **Mr. R. E. Lapean,** who has been appointed regional director of Cyanamid in Europe.